

**A MIXED METHODS STUDY OF PARENTAL AND
FAMILY FACTORS ASSOCIATED WITH
CHILDREN'S HOME TOOTHBRUSHING
FREQUENCY**

Rob Trubey

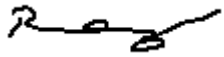
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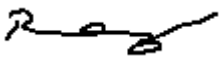
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SUMMARY

A significant number of young children in the United Kingdom experience dental caries, often resulting in a diminished quality of life. Brushing children's teeth twice a day with fluoride toothpaste significantly reduces their risk of caries, but not all parents adhere to these guidelines. Previous behaviour change interventions in oral health have been largely unsuccessful and criticised for a narrow focus on education with no wider theoretical underpinnings. However, little is known about the factors that influence parents' decisions about when and how often to brush their child's teeth at home.

The aim of the current project was to understand the wider social, environmental and cognitive factors that influence parents' decisions about brushing children's teeth, to inform future advice and interventions.

Three studies were conducted, focused on parents of children aged between 3-6 years old, resident in deprived communities in Wales. In-depth interviews (n=15) suggested that parents only took brushing guidelines seriously if they believed other parents did so, that toothbrushing patterns were influenced by the home environment and day-to-day routines, and that parents often saw toothbrushing as having largely short-term benefits. These themes informed the development of a questionnaire survey (n=297), which showed that parents' perceptions of the norm for brushing were significantly associated with how often they brushed their own child's teeth. Parents tended to brush their child's teeth more often when brushing was automatic or 'habitual' and saw different benefits in brushing a child's teeth in the morning and evening. Finally, an experimental study (n=121) showed that parents' judgements about what constitutes a healthy number of times to brush a child's teeth were relative rather than absolute, and predicted by Range-Frequency Theory.

The findings have implications for re-considering oral health advice offered to parents, and suggest novel theoretical frameworks for developing future behaviour change interventions.

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1. INTRODUCTION

1.1. Overview of the thesis

1.1.1. Dental caries in childhood

In Wales, national epidemiological surveys show that 41% of five year-old children experience dental caries: that is, they have at least one decayed, missing or filled tooth. The disease is distributed unevenly across the population, with children from deprived communities more likely to experience caries, and having a greater number of affected teeth on average.

Dental caries can lead to a number of unpleasant consequences for children. Tooth decay can cause children acute pain, and in some cases can lead to infection. Pain from tooth decay can disrupt a child's sleep patterns, eating and school attendance. Decayed teeth in young children may need to be extracted, a procedure which often requires the use of a general anaesthetic. Receiving a general anaesthetic is frequently a traumatic experience for a child and is a procedure which carries a small risk of death. In Wales, almost 10,000 children each year are given a general anaesthetic for extraction of decayed teeth.

1.1.2. The role of toothbrushing in preventing dental caries

Dental caries has a complex aetiology, but it is considered a preventable disease because it can be largely controlled by two lifestyle factors: limiting dietary sugar intake, and adopting good oral hygiene practices.

An important aspect of a child's oral hygiene is the frequency with which they have their teeth brushed at home. Almost all commercially available toothpastes contain fluoride as their main active ingredient, and fluoride is known to prevent and reverse the demineralisation process which leads to tooth decay. Systematic reviews of clinical trials have conclusively shown that brushing with toothpaste containing fluoride

significantly reduces the incidence of caries in children, and that brushing twice a day has significant benefits over brushing once a day or less. National clinical guidelines accordingly recommend that parents brush children's teeth twice each day at home. However, representative UK surveys show that over a quarter of parents brush their child's teeth less often than recommended, with parents from deprived communities reporting the least frequent brushing.

Encouraging and helping more parents to brush their child's teeth twice daily would help reduce the burden of dental caries in childhood. However, bringing about this sort of behaviour change first requires an understanding of the factors that influence parents' decisions about how often to brush their child's teeth at home.

1.1.3. Previous research

In the past, oral health interventions have been criticised for lacking a theoretical basis, and for focusing solely on providing people with information about best practice, without considering their wider circumstances. Numerous reviews have found a uniform failure to improve people's toothbrushing habits through interventions based on this type of educational approach.

There is widespread recognition that behaviour change interventions need to be underpinned by coherent theoretical frameworks. While there has been a gradual increase in research looking at parental factors which might influence children's oral health, these have either lacked a theoretical basis or tended to focus on a fairly narrow group of psycho-social theories such as the Theory of Planned Behaviour and the Health Belief Model. These theories have often been criticised for failing to take into account the importance of people's wider social, economic and environmental circumstances as potential determinants of their behaviour.

In the wider health literature, there is growing evidence that changing people's knowledge, attitudes and beliefs does not always translate to changes in behaviour. Many people are completely aware of the dangers of smoking or excessive alcohol

consumption, for instance, and yet do not change their behaviour. Similarly, many people intend to exercise more often, or eat more healthily, but subsequently fail to put these good intentions in to practice.

1.1.4. Defining the problem

These observations have been referred to as the 'knowledge-behaviour gap', 'attitude-behaviour gap' and the 'intention-behaviour gap'. Collectively, they suggest that education, advice and interventions which focus solely on trying to change a parent's oral health knowledge or attitude towards oral health are unlikely to bring about sustainable changes in their behaviour. Instead, there is a growing acknowledgement that education and interventions need to account for people's wider social, economic and environmental circumstances in order to promote behaviour change. There is also a body of research that suggests that people's innate 'cognitive biases' can influence their health-related behaviour.

The problem is that there is currently a very poor understanding of how such wider factors might influence parents' decisions about when and how often to brush their child's teeth at home.

1.1.5. The present research

The current PhD project sought to address this shortcoming, through a series of studies which focused on parents of young children, resident in deprived communities in Wales. Its aim was to understand the factors which influenced how often these parents brushed their child's teeth each day, and how these decisions were influenced by their daily lives and circumstances.

The project began with a qualitative study, comprising in-depth interviews with fifteen parents of young children. The questions were deliberately open-ended, and aimed at understanding the factors which were relevant to this particular group of parents and their circumstances, rather than applying existing ideas or theories. The ideas and

concepts generated from this first study were then explored using a questionnaire survey of 297 parents of young children. Finally, 120 parents took part in an experimental study, designed to explore how parents make decisions about what constitutes a 'healthy' or 'unhealthy' number of times to brush a child's teeth each week.

The results suggested that parents often differ in their motivation for brushing their child's teeth. Many parents focus as much (if not more) on the cosmetic benefits of brushing a child's teeth, compared with the more traditionally emphasised clinical benefits. Furthermore, there was a noticeable difference between parents' reasons for brushing a child's teeth in the morning (typically more short-term) and the evening (typically more long-term). The work also highlights the fact that brushing a child's teeth is deeply embedded in to parents' wider daily routines and schedules, so that external factors such as parental work patterns and childcare arrangements have the potential to influence a child's oral hygiene. Parents were more likely to adhere to the twice a day recommendation when the act of brushing their child's teeth becomes 'automatic' or habitual, but achieving this goal appeared to be more difficult for parents whose day-to-day routines were relatively more chaotic.

The results also showed that almost all parents were aware of the 'twice-a-day' recommendation, but that they did not always take it seriously. Instead, their behaviour, and their satisfaction with that behaviour, appeared to be influenced by perceptions about what other parents did (social norms). The final study explored the extent to which a particular theory of decision making, Range Frequency Theory, could explain parents' oral health judgements. Range Frequency Theory is a theory of how people make relative judgements, which has been used to successfully predict people's decision making in a range of fields, but has never been applied to oral health. It correctly predicts that people's satisfaction with their salary, for instance, depends not on the salary itself, but on how a person thinks that the salary compares with a group of their peers or colleagues. The results showed that parents' decisions about what was a

healthy or unhealthy number of times to brush a child's teeth were similarly relative: parents judged the same brushing frequencies (e.g., 7 times per week) as more or less healthy depending on the other brushing frequencies they were shown at the same time.

1.1.6. Benefits of the work

By considering a wider range of factors which influence parents' decisions about brushing their child's teeth, the results suggest a number of ways in which practitioners and educators can be more persuasive in their attempts to promote behaviour change: by being aware that parents have many different reasons for brushing their child's teeth (and that these often vary at different times of day); by taking into account parents' home routines and encouraging the development of a twice-daily toothbrushing 'habit'; and by providing more information about what *other* parents do, rather than simply telling parents what they should do.

In routines and habits, social norms, social comparison and motivation, the work highlights a number of areas which have received attention in the wider health literature, but which are novel to the field of oral health behaviour. Each of these areas would benefit from further research in oral health.

Most importantly, by demonstrating that parents' decisions about oral health are consistent with habit theory and Range Frequency Theory, the results offer a clear theoretical framework to inform the design of future oral health interventions aimed at increasing the frequency with which parents brush their children's teeth in the home.

1.2. The context of the project

1.2.1. The Designed to Smile scheme

This PhD project arose from a wider process evaluation of the Designed to Smile scheme, funded by the Welsh Government.

Designed to Smile is a national, supervised school toothbrushing scheme which is sponsored by the Welsh Government. It involves staff from the Community Dental Service (CDS) training teachers and classroom assistants to supervise a daily classroom session in which children brush their teeth as a group. It operates in nursery schools and primary schools across Wales, and is targeted primarily at schools in areas of socio-economic deprivation.

The process evaluation comprised several different projects, and views were sought from various stakeholders in the scheme, including the Community Dental Service staff and school staff who oversaw the programme. One aspect of the evaluation was to interview parents whose children took part in the toothbrushing programme, in order to find out their opinion on the scheme. Questions initially focused on parents' perception of how well the scheme was working, whether they felt that the children enjoyed taking part, and the extent to which they thought the scheme was a good use of school resources. However, the interviews tended to result in parents discussing the various challenges of brushing their child's teeth at home, and this led to the development of the current project.

In addition to the supervised toothbrushing programme, one of the aims of the scheme is to provide oral health education to children and their parents. The results from this project have accordingly been disseminated to the Welsh Government and staff from the Community Dental Service, with recommendations for providing better, more persuasive messages aimed at parents of children who take part in the scheme.

1.3. Thesis structure

The remaining chapters of this thesis are structured as follows:

Chapter 2 is a review of the literature. This chapter considers the wide range of determinants of dental caries in childhood, and the role of regular toothbrushing as a means of delivering fluoride to children's teeth, with particular emphasis on the frequency of brushing. The chapter considers the role that parents play in determining a child's toothbrushing frequency, and looks at previous efforts to encourage changes in people's oral health behaviour. The limitations of approaches which focus solely on people's knowledge and attitudes are considered, with evidence drawn from the wider health literature. Finally, this chapter gives an overview of research from three areas of psychology and behavioural economics which may be of relevance to understanding parents' decisions about their child's toothbrushing: social norms and comparisons, motivation and cognitive biases, and habits and routines.

Chapter 3 states the aims and objectives of the thesis, and gives an overview of the project's "mixed-methods" approach, outlining the way in which different research methods were employed in the three separate studies.

Chapter 4 describes the first study of the project, which involved in-depth interviews with fifteen parents of children aged 3-6 years old.

Chapter 5 describes the second study of the project, a questionnaire survey answered by 297 parents of children aged 3-6 years old, focusing on brushing their child's teeth at home.

Chapter 6 describes the third and final study of the project, an experimental study which involved administering a paper and pencil test to a further 120 parents of children aged 3-6 years old.

Chapter 7 is the final chapter of the thesis, the general discussion. This chapter reviews the key findings from the three studies and attempts to synthesise the results. Some of the broader limitations and potential sources of bias of the thesis are

considered here, and then finally the implications of the findings are considered and recommendations made for practitioners, health educators and oral health researchers.

1.4. Publications

To date, three papers based on work from this PhD thesis have been published in peer-reviewed oral health journals:

- The first paper was based on the qualitative study described in Chapter 4, and was published in the *International Journal of Paediatric Dentistry* (Trubey et al., 2014). This article is presented as Appendix 9.
- The second paper was based on the questionnaire survey described in Chapter 5, and has been accepted for publication in *Caries Research*. This article is presented as Appendix 10.
- The third paper was also based on the questionnaire survey described in Chapter 5, and has been accepted for publication in *Community Dental Health* (10.1922/CDH_3512Trubey06). This article is presented as Appendix 11.

2. LITERATURE REVIEW

2.1. Dental caries in childhood and its epidemiology

2.1.1. Dental caries in children

Dental caries or tooth decay is the most common oral disease and one of the most chronic diseases of people worldwide (Selwitz et al., 2007). The term “dental caries” is sometimes used to describe the process of tooth decay, but also more commonly to describe its result or symptoms: the ‘cariou lesion’ or cavity which results from the destruction of tooth enamel, dentin and cementum (Fejerskov and Kidd, 2008).

The process of caries development can occur as soon as the deciduous or primary teeth erupt, so children are vulnerable to the disease from a very young age. This section considers the way in which dental caries is typically measured and reported at a population level, and explores recent trends and current epidemiology of the disease in young children.

2.1.2. Measuring caries experience

Caries experience in the primary dentition is typically recorded using the dmf index: a basic count of the number of teeth which are judged by visual inspection to be decayed (d), missing (m) or filled (f). Data collected in epidemiology surveys using the dmf index can be used to report on the severity and prevalence of the disease at a population level. The *severity* of the disease is typically measured by the average number of decayed, missing or filled teeth (mean dmft) per child, while *prevalence* is typically measured by the proportion of the children in the population who have at least one decayed, missing or filled tooth (% dmft>0).

Defining what counts as a carious tooth or surface is an important part of any epidemiological survey. Most commonly, surveys rely on ‘clinical-visual’ criteria for

assessing and recording caries, which means that they are effectively measuring 'obvious decay experience' (Figure 2.1).

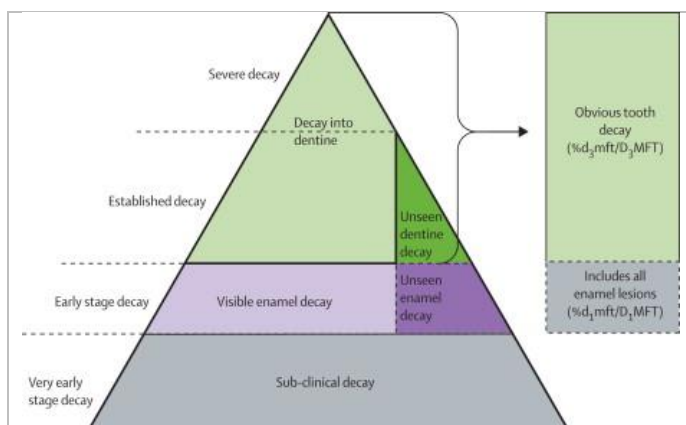


Figure 2.1: The iceberg metaphor for different diagnostic thresholds in measuring dental caries, from Pitts (2004)

The dmf index has been in use for over 80 years, with only minor amendments. Some researchers have noted problems with the index, including the assumption that filled and missing teeth are assumed to have been carious, and the equal weighting assigned to decayed, filled and missing teeth (Broadbent and Thomson, 2005). Despite these problems, the history and widespread use of the dmf index means that it is possible to observe broad trends in caries experience over time, and gives a picture of how common the disease is in current populations.

2.1.3. Trends in dental caries in children

UK surveys

In the United Kingdom, the Child Dental Health Survey has involved examinations of children aged five years old every ten years, from 1973 to 2003. The surveys have used broadly consistent methodologies for measuring and reporting caries, allowing comparisons across time. Figure 2.2 shows caries experience over time, illustrating a steep decline in both the prevalence (red bars) and severity (blue line) of the disease from 1973 to 1983, followed by a shallower decline in subsequent years.

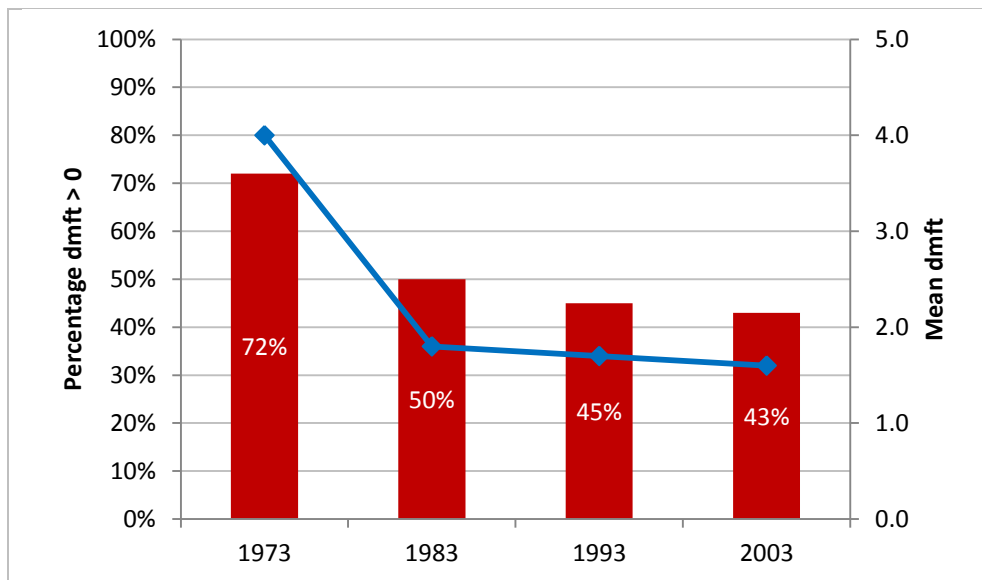


Figure 2.2: Trends in caries prevalence and severity in five year-olds in the UK, 1973-2003

In addition to the Child Dental Health Survey data, more frequent surveys of five-year olds have been carried out in England, Scotland and Wales under the co-ordination of the British Association for the Study of Community Dentistry (BASCD). They suggest that while caries prevalence in five-year olds has slowly reduced, the decline is far shallower than has been observed in previous decades (Pitts et al., 2007). However, subsequent national surveys in Scotland, Wales and England have suggested improvements in recent years, though year-to-year comparisons are complicated by changes to consent arrangements. The most recent nationally comparable survey from the UK found that between 38 and 53% of children had evidence of caries experience at age five, with noticeable variations between countries (Pitts et al., 2007). Subsequent national surveys have found improvements in recent years. In Scotland, for instance, the National Dental Inspection Programme conducts assessments of children aged 5.5 years on average, and has shown a fall in both prevalence and severity of caries since 2003. In 2003, for instance, 55% of children had obvious decay experience, whereas that figure had reduced to 32% at the last inspection in 2013/14 (Scottish National Dental Inspection Programme, 2014).

European and international trends

Broadly similar trends in decay experience in the primary dentition have been reported in other industrialised countries with regular epidemiology programmes, both within and outside of Europe (Marthaler, 2004, Petersen et al., 2005).

In Sweden, for instance, caries prevalence in 4 year-old children declined from 87% in 1967 to 42% in 1987, but then showed little improvement in the following fifteen years (Stecksen-Blicks et al., 2004). In the United States, caries prevalence in 2-5 year old children fell dramatically in the 1960s and 1970s, but showed little improvement between surveys conducted between 1988-1994 and 1998-2004 (Dye et al., 2007).

2.1.4. Current caries experience and distribution of the disease

While many countries have seen dramatic declines in childhood caries over the past four decades, it is important to note that the disease still affects significant groups of the child population within these countries.

In the United States, the most recent nationally representative survey found that dental caries in the primary dentition was present in 28% of children aged 2-5 years old (Dye et al., 2007). An earlier report from the Surgeon General called dental caries “the most chronic disease of childhood”, reporting that it was five times more prevalent than asthma and seven times more prevalent than hayfever (US Surgeon General, 2000). In Australia, the prevalence of caries among five-year old children was reported to be 48% in the latest available survey conducted in 2010 (Australian Institute of Health and Welfare, 2014).

Table 2.1 summarises some of the most recent epidemiological findings from studies using representative samples of children aged six or under, including more recent data from national surveys carried out in the United Kingdom. While the surveys are not directly comparable because of difference in diagnostic thresholds, they give a broad picture of caries experience in young children across a number of industrialised

countries. Despite improvements in many countries, they illustrate that caries remains a problem for significant numbers of children.

Study/source	Survey year	Country / area	Children's age (yrs)	Percentage dmft>0	Mean dmft
Welsh Oral Health Information Unit (2012)	2011-2012	Wales	5	41%	2.38
Scottish National Dental Inspection Programme (2014)	2013-2014	Scotland	5	32%	1.27
Public Health England (2013)	2011-2012	England	5	28%	0.94
Statistics Norway (2013)	2013	Norway	5	17%	0.70
Dye et al., (2007)	1998-2004	United States	2-5	28%	1.17
Australian Institute of Health and Welfare (2014)	2010	Australia	5	48%	2.32
New Zealand Ministry of Health (2010)	2009	New Zealand	5	44%	1.82

Table 2.1: Surveys of international prevalence and severity of dental disease in children from selected industrialised countries

Inequalities in caries experience

Figures which report caries experience at a national level can mask the distribution of the disease within sub-groups of the population. One trend which can be observed in recent surveys of young children's caries experience is that the prevalence of the disease has fallen, while the severity of the disease has remained fairly stable. This pattern points to a change in the distribution of the disease across the population, whereby a smaller percentage of children are experiencing caries but at an increasing level of severity.

As with many childhood diseases, the prevalence and severity of dental caries in children tends to be strongly associated with various measures of family or neighbourhood socio-economic status. Within industrialised countries, both the prevalence and severity of caries tend to increase in parallel with increasing levels of relative deprivation (Bernabe and Hobdell, 2010).

2.1.5. Welsh data

In the UK, the last set of comparable dental surveys undertaken found that the oral health of five year-old children in Wales was worse than that of children in England and Scotland, with over half of the five year-olds surveyed experiencing obvious decay (Pitts et al., 2007)

A more recent nationally representative survey of five year-olds in Wales was conducted in 2011/2012 and found that 41% of all children examined had obvious decay experience (Welsh Oral Health Information Unit, 2012). The severity of caries was heavily skewed among children in the Welsh population. While the majority of those aged five have no dental disease, the 41% of children who do experience the disease have an average of 3.7 teeth which are decayed, missing or filled.

There was also a clear association between both the prevalence and severity of dental disease and socio-economic status as measured by the Welsh Index of Multiple Deprivation (Figure 2.3). The Welsh Index of Multiple Deprivation is the official area-based measure of socio-economic deprivation in Wales, which considers factors such as income, education levels, housing, employment and access to services (Welsh Government, 2011). Small geographical areas are assigned a score, which can then be collapsed in to one of five 'quintiles' of deprivation, ranging from 1 (least deprived) to 5 (most deprived). The graph shows a clear 'social gradient' whereby mean dmft scores are twice as high in children from the most deprived areas compared to those from the least deprived areas. The quintiles are based on the 2011 version of the Welsh Index of Multiple Deprivation.

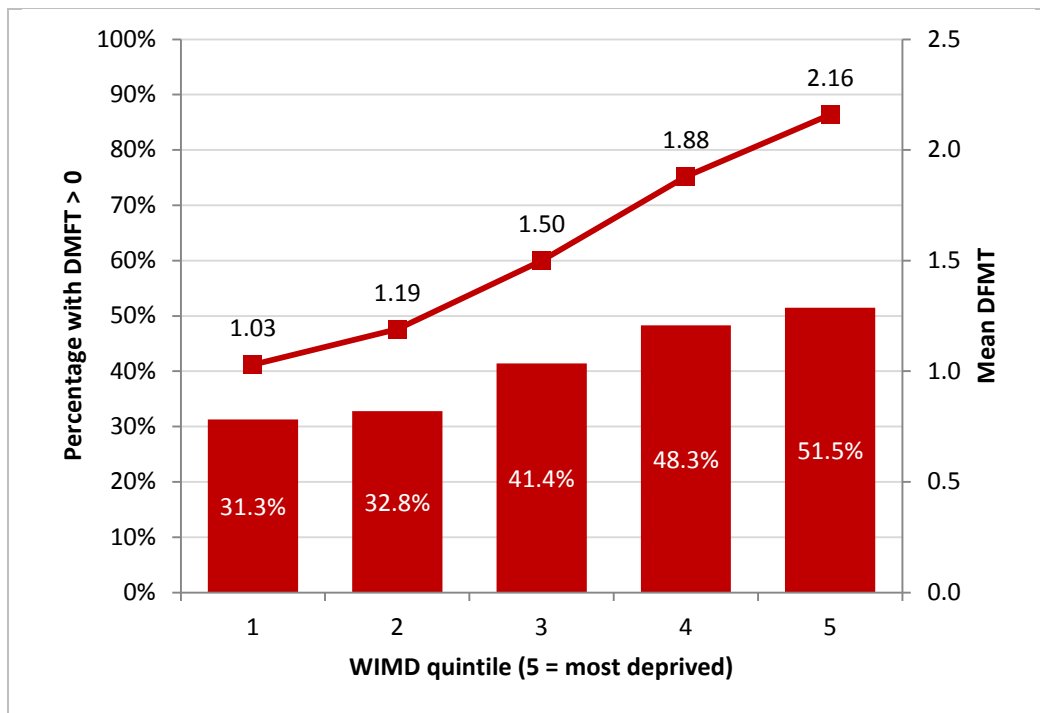


Figure 2.3: Incidence and prevalence of dental disease in 5-year old children from Wales, by Welsh Index of Multiple Deprivation (2011) deprivation quintile (Welsh Oral Health Information Unit, 2012)

2.1.6. Summary

Despite great improvements over the last four decades, dental caries remains a significant problem for many children in the UK and other industrialised countries. In Wales, recent surveys suggest that caries affects over two-fifths of five year-old children, and is a particular problem in areas of high socio-economic deprivation.

The following section considers the way in which dental caries can impact the daily lives of children who experience the disease and their families.

2.2. The impact of dental caries in childhood

In addition to objective measures of disease such as the dmft index, it is important to consider the way that caries can affect and limit the daily lives of affected children. The following section reviews evidence of the impact that caries can have for children and their families.

2.2.1. Pain and infection

Cross-sectional studies have found that parents of children with decayed teeth are significantly more likely to report that their child has experienced toothache or oral pain than those who have no decay. The 2003 Child Dental Healthy Survey, for instance, asked parents to report if their five year-old child had experienced any oral conditions or problems in the previous 12 months. Parents of children with obvious decay were more than twice as likely to report their child having experienced at least one episode of 'toothache or a sore mouth' compared to parents of children who had no obvious decay (25% vs. 10%) (White et al., 2006).

Increased severity of decay appears to increase the odds of experiencing pain. Milsom and colleagues analysed the case notes of 577 children from 50 General Dental Practitioners in the UK. They found that the odds of a dentist reporting that a child had experienced at least one episode of pain in their primary molars increased by 10% for each carious tooth present. Increased caries experience was also associated with significantly higher odds of extraction of a primary molar due to pain or sepsis (OR: 1.16) and with children having been prescribed a course of antibiotics (OR: 1.23) (Milsom et al., 2002).

Data from dental inspections in Scotland suggest that increased severity of dental decay in children is also associated with a higher risk of infection. Pine and colleagues analysed clinical data from 6,994 five year-old children, where 4.8% (n=337) were identified by examiners as having dental sepsis. Binary logistic regression showed that

the odds of a child experiencing dental sepsis increased by 37% for each additional decayed tooth present (Pine et al., 2006).

2.2.2. Quality of life

Health-related Quality of Life (HRQoL) is a broad term employed in health research to measure the way in which disease, disability or illness can affect a person's "optimal functioning and social and psychological well-being". Various tools have been developed to measure the impact of oral health on people's wider quality of life, though only a few have been designed specifically for use with young children.

Pahel and colleagues adapted Slade's Oral Health Impact Profile for use with parents of children aged 3-5 years old (Pahel et al., 2007). The Early Childhood Oral Health Impact Scale (ECOHIS) asks parents to report their child's experience of oral pain, but also the extent to which dental problems have affected the child's daily activities such as eating and chewing, sleeping and socialising. Further items measure the impact of a child's dental problems on other family members, including the financial impact of dental problems. The various items included in the measure (Figure 2.4) serve to illustrate the many ways in which caries can potentially affect children and families.

Research using the ECOHIS has found that parents of children with dental caries tend to report significantly worse outcomes for both the child and the family. Martins-Junior and colleagues administered the ECOHIS to 638 parents of children aged five years old in Brazil. Significantly higher ECOHIS scores (indicating worse outcomes) were reported for parents of children with higher caries experience compared to a caries-free reference group, even when controlling for covariates such as socio-demographic factors (Martins-Junior et al., 2013).

Child impacts
How often has your child had pain in the teeth, mouth or jaws?
How often has your childbecause of dental problems or dental treatments?
(had difficulty drinking hot or cold beverages)
(had difficulty eating some foods)
(had difficulty pronouncing any words)
(missed preschool, daycare or school)
(had trouble sleeping)
(been irritable or frustrated)
(avoided smiling or laughing)
(avoided talking)
Family impacts
How often have you or another family member.....because of your child's dental problems or treatments?
(been upset)
(felt guilty)
(taken time off from work)
How often has your child had dental problems or dental treatments that had a financial impact on your family?

Figure 2.4: Items from ECOHIS scale (Pahel et al., 2007)

One of the shortcomings of tools such as the ECOHIS is the reliance on parental reports, which may not always accurately reflect the child's own experiences. Tsakos and colleagues recently reported preliminary findings from a measure called the 'Self-reported scale of oral health outcomes for 5 year-old children' (SOHO-5), developed for five year-old children to complete themselves. They administered the questionnaire to 326 five year-old children and found that the measure was able to differentiate between children with caries and caries-free controls: those children with caries were significantly more likely to report problems with their teeth limiting their ability to "eat, drink, sleep, play or smile" (Tsakos et al., 2012).

2.2.3. Body weight

The relationship between dental disease and children's physical development in terms of height and body weight is not straightforward. Some studies have reported

significantly lower body weights in children with severe or untreated caries compared to caries-free peers, with researchers often inferring that untreated decay may negatively affect a child's ability to eat and chew food (Acs et al., 1999). Other studies have shown a link between child obesity and greater caries experience, suggesting that the level and frequency of sugar consumption as a common risk factor for both (Marshall et al., 2007).

A recent systematic review by Hooley and colleagues, in considering studies which investigated the link between body mass index (BMI) and caries, found mixed results: almost half of the studies they reviewed found no association between caries and BMI. However, they found some evidence that caries might be more prevalent among children with particularly low and particularly high BMI levels, and speculated that different factors may be involved in the development of caries in children with low and high BMI (Hooley et al., 2012a).

2.2.4. Extractions and hospital admissions

Treating young children's decay in a dental setting can be complicated by either the severity of the decay, or difficulties managing young children. For many children, treatment may require the administration of a general anaesthetic (GA), which in the UK now needs to be carried out in a hospital setting. The use of a GA carries small but potentially serious risks to the child, and researchers have reported that children often find such procedures to be traumatic (Bridgman et al., 1999, Hosey et al., 2006). Treating children in hospital settings also results in significant economic costs, either to the healthcare system or the child's family (Casamassimo et al., 2009).

In the UK, extraction of severely decayed teeth has been reported as the most common reason for hospital admissions for general anaesthetic in young children (Moles and Ashley, 2009). Recent estimates in Wales suggest that 9,696 children underwent a general anaesthetic for tooth extraction in 2010-11 (Welsh Government, 2013). This is a situation which the Welsh Government has called "a risk to child health

and wellbeing that would not be tolerated in other diseases” (Welsh Government, 2013).

2.2.5. Dental anxiety and fear

Children who undergo painful or invasive treatment in a dental or hospital setting might be expected to develop a general adversity to visiting dental settings in the future.

Various methodological challenges exist in measuring dental anxiety or fear in young children. Most studies rely on parental reports of a child’s anxiety, with research reporting only moderate agreement between parental and child reports of anxiety (Luoto et al., 2010). It is possible that parents may conflate their own feelings about dental visits with their child’s feelings. Indeed, several studies suggest that a parent’s own dental anxiety is often closely associated with their child’s feelings about attending a dentist (Themessl-Huber et al., 2010). A recent systematic review by Porritt and colleagues observed that numerous different measures of anxiety have been used by researchers, suggesting a lack of uniformity in the way the concept has been measured (Porritt et al., 2013).

Cross-sectional and cohort studies have found significant associations between a child’s treatment history, caries experience and dental anxiety. Tickle and colleagues followed a cohort of 1,404 children from age 5 to age 9. They found that children with a history of extractions were significantly more likely to be dentally anxious at nine years old (Tickle et al., 2009). Another prospective study by Raadal and colleagues showed a significant relationship between the prevalence of caries at age five and the child’s dental anxiety aged ten (Raadal et al., 2002).

Causal pathways are difficult to establish, however. Negative experiences in a dental practice or hospital setting may well lead to later anxiety about dental treatment. However, it is likely that children’s dental health, dental anxiety, avoidance and their treatment experience are all heavily inter-linked. The result can be what Armfield calls a “vicious cycle, whereby the experience of dental anxiety and fear results in greater

avoidance and delaying of dental visiting, deteriorated oral health with higher treatment need, and the tendency to visit for the relief of problems rather than for a check-up” (Armfield et al., 2007).

2.2.6. Caries in childhood and caries in adulthood

Longitudinal studies carried out in New Zealand, Brazil and Scandinavia have demonstrated a clear link between experience of caries in the primary dentition and subsequent experience of caries in the permanent dentition. This has been demonstrated both later in childhood (Skeie et al., 2006, Peres et al., 2009) and in adolescence or adult life (Thomson et al., 2004). Thomson and colleagues, for instance, have tracked a cohort of almost 800 people born in New Zealand in the early 1970s, carrying out dental inspections at regular intervals. They reported a significant relationship between caries experience at age 5 and caries experience at age 26, even when controlling for childhood and adulthood socio-economic status. The authors concluded that “the evidence was unequivocal where dental caries is concerned: having high disease experience early in life predicted having greater disease experience in adulthood, other factors being equal” (Thomson et al., 2004).

2.2.7. Summary

Childhood caries can have a range of negative impacts on children and their families. Children with decay experience are far more likely to experience oral pain and infection, and may require hospital admission for treatment under general anaesthetic. Research using “quality of life” measures point to a number of wider social, developmental and economic impacts of severe tooth decay. Importantly, caries experience in the primary dentition is associated with significantly higher risk of caries experience later in life.

The following section considers what is known about the aetiology of caries, its determinants and how it might be prevented.

2.3. Aetiology, determinants and prevention of childhood caries

2.3.1. Limitation of treatment approach

At present, it is rare for children with decay in primary teeth to receive restorative work. Data from surveys conducted in the United Kingdom show that as much as 90% of dental caries in 5-year olds is untreated (Pitts et al., 2007). There is currently no clear consensus within the dental profession as to the benefit of different options for decay in primary teeth, and a multi-centre trial is currently underway in the UK to explore the clinical and cost-effectiveness of various different clinical approaches (Innes et al., 2013).

There is, however, widespread recognition that treatment alone cannot reduce the burden of dental caries among the child population. Many national and international policy documents and guidelines advocate a re-orientation of dental services towards a preventative, rather than a "reactive" approach to tackling the disease (Petersen, 2009, Welsh Government, 2013, Scottish Intercollegiate Network Guidelines, 2014, Public Health England, 2014). The Welsh Government's National Oral Health Plan, for instance, states that "reducing the risk factors that lead to oral disease is only possible if the delivery of dental services and oral health improvement programmes are oriented towards primary health care and prevention" (Welsh Government, 2013).

In order to understand how childhood caries can be best prevented, it is important to consider the aetiology and the wider determinants and risk factors associated with the disease.

2.3.2. Dental caries aetiology

Dental caries is an infectious disease, caused by the presence of certain bacteria in the oral biofilm which are able to ferment sugars and other carbohydrates to produce acid (Fejerskov and Kidd, 2008). This process causes fluctuations in pH levels in the biofilm (or dental plaque) which cover the tooth surface. The net effect of these fluctuations in

pH levels within the biofilm leads to either demineralisation of the tooth enamel at low pH-levels, or remineralisation of the enamel surface at higher pH-levels. Fluctuations occur regularly in the biofilm, but caries lesions form when there is a consistent pattern of pH drops resulting in a net loss of mineral from the dental enamel over time.

Importantly, the process of acid production occurring in the biofilm can either be aided or significantly slowed by various local factors in the oral environment. These include:

- Salivary flow
- The presence of fermentable carbohydrates
- The concentration of fluoride ions in the oral fluid
- The composition and thickness of the plaque biofilm.

The caries balance

As well as slowing the process of demineralisation caused by acid production, certain salivary components such as calcium, phosphate and fluoride can actually promote remineralisation of tooth enamel and so stop or reverse the development of cavities (Buzalaf et al., 2011) The caries process has therefore been conceptualised as a “delicate balance...determined by the relative weight of the sums of pathological factors (acid-producing bacteria, fermentable carbohydrates) and protective factors (saliva, calcium, phosphate and fluoride)” (Featherstone, 1999). Figure 2.5 illustrates this conceptual balance.

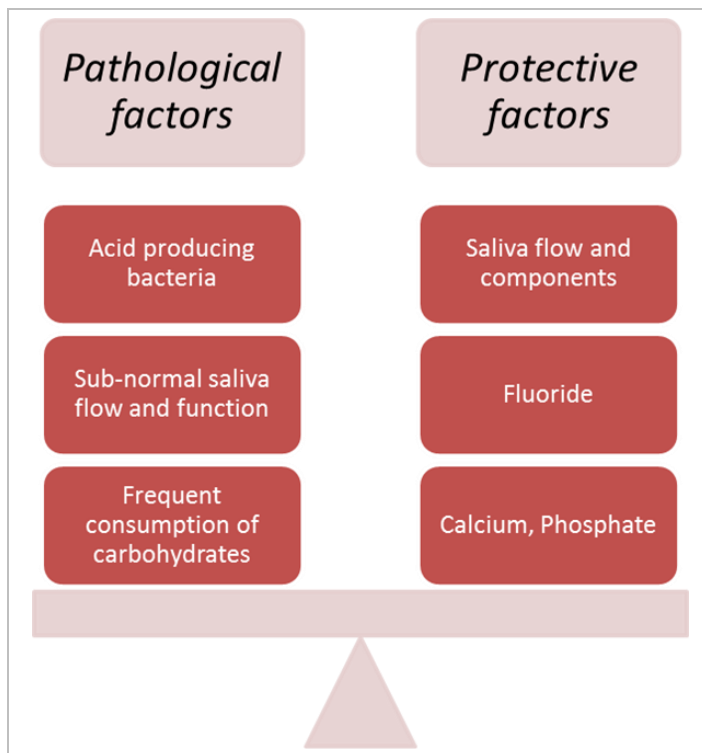


Figure 2.5: Illustration of the 'caries balance', adapted from Featherstone (1999)

2.3.3. Determinants of caries and implications for prevention

The implication of this 'caries balance' is that any factors which serve to influence the presence of the various pathological and protective factors in the oral environment can contribute to the risk of caries development. Accordingly, a vast number of determinants of childhood caries have been identified in the literature. For example, a 2004 systematic review by Harris and colleagues identified over 100 risk factors associated with caries in childhood, including factors related to socio-demographics, oral hygiene, diet, feeding practices and oral bacteria flora (Harris et al., 2004).

Figure 2.6 shows a conceptual model of influences on children's oral health, by Fisher-Owens and colleagues. The model serves to illustrate how the complex aetiology of dental caries lends itself to many different perspectives on the determinants of the disease, each of which in turn lend themselves to different preventive approaches (Fisher-Owens et al., 2007)

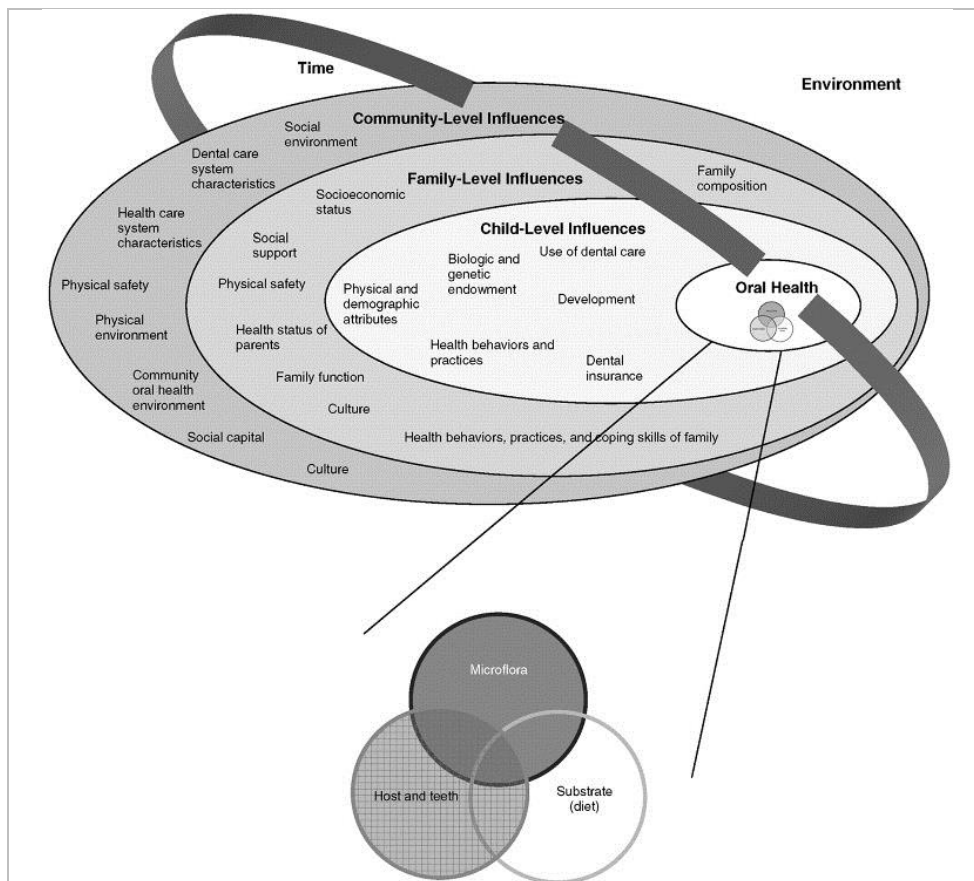


Figure 2.6: Conceptual model of influences on children's oral health, from Fisher-Owens et al, (2007)

A microbiological perspective

Because caries is primarily an infectious disease, many studies have focused on the transmission and presence of certain groups of bacteria as being a key determinant of childhood caries. Mutans streptococci (MS) have been identified, for example, as one of the key pathogens involved in caries. The possibility of early transmission from mother to infant has been investigated for many years (Kohler et al., 1983), and a recent systematic review reported that such early transmission can be associated with increased risk of caries development in childhood (Parisotto et al., 2010). An earlier systematic review found that MS tend to be found in greater frequency among children with caries compared to caries-free peers (Thenisch et al., 2006), although many other bacteria (including *Lactobacillus* spp.) are likely to be involved in the caries process.

From this microbiological perspective, preventive approaches might include efforts to prevent or delay transmission of MS to the child, the development of topical antimicrobial agents aimed at preventing key bacteria from reaching pathological

levels, vaccination or gene therapy and methods to stimulate salivary flow (Berkowitz, 2003, Fejerskov and Kidd, 2008). However, to date, none of these approaches have been shown to be clinically effective in a widespread or sustainable fashion.

A social and environmental perspective

There is increasing awareness that the traditional 'biomedical' approach to understanding disease – that is, a focus on genetics and biology - needs to be complemented with an understanding of the way in which people's social and environmental conditions can influence their health (Marmot and Wilkinson, 2005).

Even among young children, there is a wealth of evidence that lower socio-economic status (SES) is associated with increased prevalence and severity of dental caries. A systematic review by Reisine and Psoter looked at 59 studies exploring the relationship between SES and caries experience in children aged 6 and under (Reisine and Psoter, 2001). The studies included were largely cross-sectional and caries diagnosis and definitions of SES varied between countries, but the authors concluded that "the preponderance and consistency of the inverse relationship between SES and caries, considered in aggregate, are supportive of lower levels of SES being a risk factor for dental caries in young children". A more recent review by Hooley and colleagues, considering studies published since 2006, also found 'robust' evidence that lower social class or income was associated with a greater risk of caries in children (Hooley et al., 2012b). This social patterning of disease suggests that wider factors are involved in the development of caries.

While there is ample evidence that socio-economic deprivation is associated with greater risk of caries experience in children, the specific pathways via which deprivation exerts its effect on a child's oral health are less clear.

One possibility is that social and environmental conditions associated with deprivation may influence children's oral health by making it more difficult for them (or their parents) to make healthy lifestyle choices relating to diet and oral hygiene (Pine et al., 2004b). Some researchers take a life-course approach and argue that higher levels of

stress commonly reported in low-SES households may increase a child's susceptibility to caries through associated changes to salivary flow, enamel development and general immune function (Nicolau et al., 2007, Boyce et al., 2010b).

In either case, the clear association between relative socio-economic deprivation and childhood caries has led some researchers to argue that caries should be considered a 'disease of social deprivation' (Fejerskov and Kidd, 2008) and the inequalities in its distribution cannot be explained by lifestyle factors alone (Sanders et al., 2006). Many argue that the biggest secular reductions in dental caries would be achieved through preventive strategies which are targeted 'upstream' – that is, approaches which are aimed at changing national and local policies and legislation in order to reduce social inequality (Watt, 2007).

A lifestyle perspective

Epidemiological data also points to wide disparities in caries experience *within* socio-economic groups, as well as between them. Figure 2.7 shows that in Wales, for example, there is a clear divide in caries experience of 5 year-old children who live in areas considered to be in the most socioeconomically deprived quintile. Among this group, 48% are caries free, while the remaining 52% have on average 4.3 decayed, missing or filled teeth (Welsh Oral Health Information Unit, 2012).

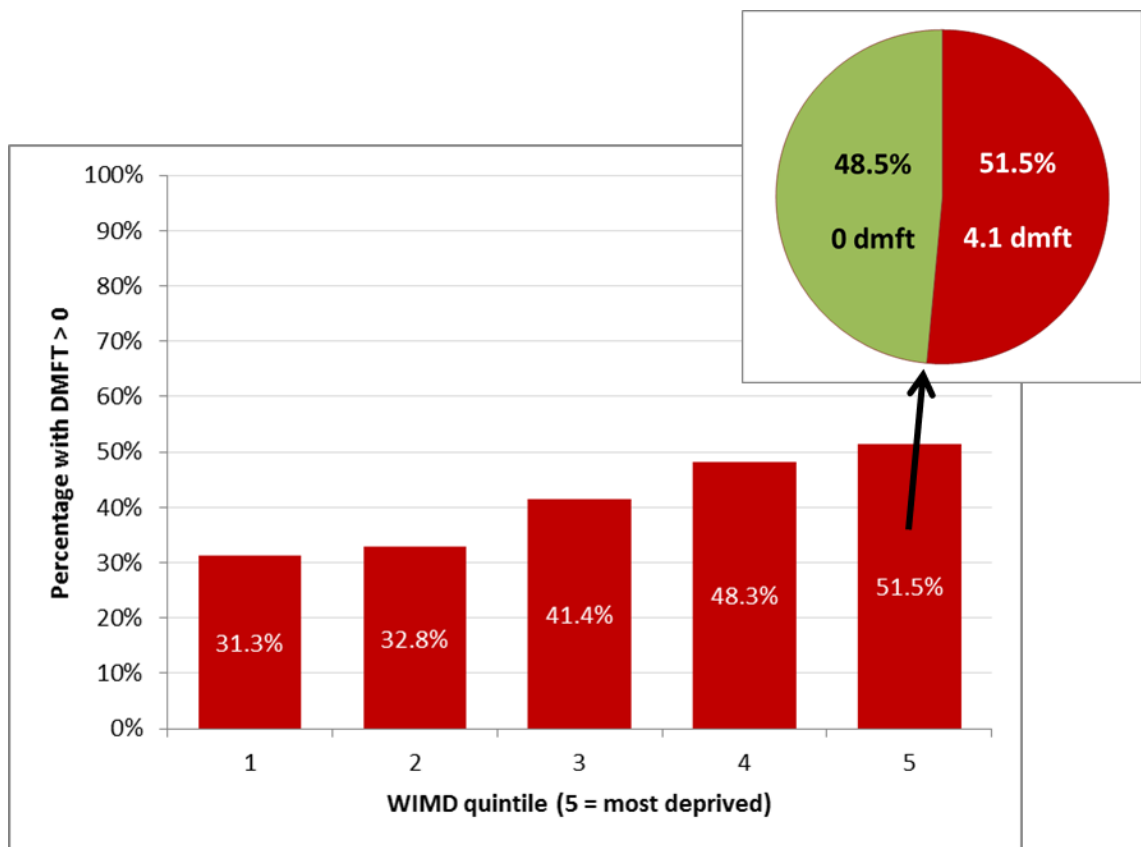


Figure 2.7: Illustration of the disparity of caries prevalence and severity within socio-economic groups in Welsh five year-olds (Welsh Oral Health Information Unit, 2012)

These contrasting outcomes for children whose families are resident in areas of similar levels of socio-economic deprivation highlight the importance of also considering individual difference in behaviour. This is not to dismiss the importance of social and economic conditions as determinants of oral health, but rather to suggest that it is important to understand how these factors interact with and shape people's decisions and behaviour in relation to important factors like diet and fluoride use. Hooley, for instance, argues that "it is what parents *do*, given the constraints they behave within, that determine their child's health outcomes" (Hooley et al., 2012b).

Arguably the most controllable factors in the "caries balance" of pathological and protective factors are the presence of dietary carbohydrates and fluoride. Both of these factors are highly influenced by individual behaviour: namely, diet and use of topical fluoride products such as toothpastes. Indeed, this has led many researchers to argue that dental caries is in theory an entirely preventable disease (Pine et al., 2004a). From this perspective, caries prevention involves promoting 'healthy' lifestyle factors, which

in turn requires an understanding of the reasons why people do or don't engage in such behaviours.

Diet and feeding practices

A recent systematic review conducted by the WHO Collaborating Centre for Nutrition and Oral Health looked at research pertaining to the effects of increases and decreases in children's free sugar intake and caries experience (Moynihan and Kelly, 2014). They considered 51 studies (largely population or cross-sectional) from 1950 onwards, and found evidence of a relationship between increased sugar intake and increased risk of dental caries in children. The quality of the studies was rated as 'moderate', and while the authors pointed to methodological difficulties and drawbacks inherent in the measurement of diet, they felt that the evidence was strengthened by the consistency of findings across studies.

One of the main benefits of targeting dietary sugar intake is that excessive consumption in childhood is a common risk factor for not just dental caries, but wider health conditions such as obesity and type-2 diabetes. Thus, policies or programmes which aim to improve the nutritional balance of children's diet will also have the potential to reduce the prevalence and severity of caries.

Fluoride

Of the protective factors in the caries balance, the most modifiable is the extent to which fluoride is present in the oral fluids. The following section considers the role of fluoride in preventing caries in more depth.

2.3.4. Summary

There is widespread agreement that prevention of childhood caries should be a priority in oral health. The aetiology of caries is complex, and the strong social gradient in disease experience points to the importance of considering wider social and environmental factors as determinants of caries experience. However, disease experience also varies greatly within socio-economic groups, and lifestyle factors such

as diet and fluoride exposure undoubtedly play a significant role in determining the risk of caries in childhood.

2.4. Fluorides for the prevention of caries

The discovery of fluoride as being beneficial in terms of preventing caries has its roots in observational studies carried out in the United States during the early decades of the 20th century (Dean and McKay, 1939). These studies were originally concerned with identifying the causes of ‘mottled enamel’ or ‘fluorosis’, which appeared to be endemic among children in areas where water supplies contained relatively high concentrations of fluoride. Data collected using DMFT measures showed, however, that children with ‘mottled enamel’ generally had less caries experience than those in areas without it. These discoveries eventually lead to widespread, ‘artificial’ fluoridation of water supplies in many populous areas of the United States, with subsequent reductions in caries rates. The United States Centre for Disease Control and Prevention considered community water fluoridation to be one of the top ten public health achievements of the 20th century (United States Centers for Disease Control and Prevention, 1999).

Later research led to the development and widespread adoption of commercial fluoridated dentifrices or toothpaste, which a panel of experts cited as the main reason for the dramatic decline in caries rates in many industrialised countries from the 1970s to 1980s (Bratthall et al., 1996).

The World Health Organisation now consistently advocates the use of fluoride for the prevention of dental caries in children, including the use of methods such as water fluoridation and promoting the regular use of fluoride toothpaste (Petersen and Lennon, 2004).

Anticaries mechanism of fluoride

In the mid-twentieth century, following the discoveries of McKay and Dean, it was thought that fluoride exerted its caries inhibiting properties through its incorporation into the tooth enamel during the period of tooth mineralisation pre-eruption. It was therefore referred to as a “systemic” effect. However, the understanding of how fluoride protects against dental caries has developed in recent decades. In the 1980s, researchers were

able to show that the primary explanation for the anticaries effect of fluoride is through its topical effects – that is, through its localised interaction with the tooth surface, via its presence in the oral fluids (Fejerskov et al., 1981, ten Cate et al., 1988). It is now widely accepted that the main anticaries benefit of fluoride is through its “interference with the demineralization process and the promotion of remineralization” post eruption at the tooth and oral fluid interface (Amaechi and van Loveren, 2013).

Due to the localised way in which fluoride exerts its anticaries effect, a low concentration needs to be maintained in the oral fluids to be effective (Featherstone, 1999). This has two important implications: firstly, that any dosing mechanism is dependent on regular provision of low levels of fluoride in order to be effective; and secondly, because of the ubiquitous nature of the processes which drive caries development and reversal, regular exposure to fluoride must be maintained throughout life in order to control or prevent the disease.

Balancing the benefits and risks of fluoride

Fluorosis is a condition which results from hypo-mineralisation of the tooth enamel caused by excessive systemic ingestion of fluoride in children during tooth development. It leads to mottling of the teeth in mild cases or brown staining and breakdown of the enamel in more severe cases. It is generally thought that a critical ‘window of maximum susceptibility’ occurs around the first three to four years of life, in which children are particularly susceptible to the effects of cumulative levels of fluoride ingestion (Buzalaf and Levy, 2011).

An important challenge in the delivery of fluoride, then, is to balance the topical benefits of regular fluoride exposure with the risks of fluoride ingestion in early childhood.

2.4.1. Methods of delivering fluoride

A range of different strategies have been employed to try and increase the degree to which children’s teeth come into contact with fluoride.

Fluoride delivery mechanisms can be said to fall under two broad categories: systemic and topical. Systemic methods refer to delivery systems in which fluoride is typically ingested (though as noted, the main benefits are now thought to derive from its topical effect in the oral environment). These include water fluoridation and other techniques such as fluoridation of salt or the use of fluoride tablets. Topical methods refer to the process of applying fluoride directly to the teeth and oral environment in relatively higher concentrations, where ingestion is not typical. These can be applied by professionals or self-administered, and include fluoride gels, varnishes, mouthrinse and toothpastes.

2.4.2. Systemic delivery of fluoride

The primary systemic delivery method for fluoride is through fluoridation of the water supply. Other systemic supplements do exist, but their efficacy for preventing caries in young children is unclear. A systematic review of fluoride supplements, including fluoride tablets, lozenges and drops, found insufficient evidence to support their use in young children (Tubert-Jeannin et al., 2011).

Water fluoridation

Water fluoridation refers to the controlled addition of fluoride to a local or national water supply. The concentration of fluoride in fluoridated water (typically 0.7 – 1.0 ppm F) is many times lower than in topical products such as fluoride toothpaste, but this is balanced by the likelihood of far more frequent contact with the teeth throughout the day.

Two major systematic reviews have concluded that there is a beneficial effect of water fluoridation for reducing dental caries experience and severity in children, while cautioning that the degree of benefit is difficult to calculate and that much of the available research is of low to moderate quality (McDonagh et al., 2000, Australian National Health and Medical Research Council, 2007). The 2000 York Review found

evidence that mild fluorosis was fairly common (around 48%) in areas where fluoride reached 1ppm, with around 12.5% experiencing 'aesthetically concerning' fluorosis.

One of the major advantages of water fluoridation is that it is a passive intervention, requiring no behaviour change at an individual level. Furthermore, water fluoridation can be considered a 'whole-population approach' (Rose, 1993) where the intervention is delivered to all members of a community. Therefore, one of the main proposed benefits of water fluoridation is its potential to reduce inequality in disease experience across social classes, based on the idea that all members of society are likely to have free access to drinking water (Burt, 2002) and that children from low-SES areas who would otherwise have had less contact with fluoride would accordingly benefit the most. The York review found some evidence that water fluoridation may reduce the social gradient in caries severity (but not prevalence) in five year-old children, though they cautioned that only a few, low-quality studies were available and that overall, the evidence was unreliable (McDonagh et al., 2000).

Two important considerations for any whole-population approach to promoting health are feasibility and acceptability (Daly et al., 2013). Feasibility refers to the extent to which the resources and knowledge exist to deliver an intervention, while acceptability refers to the extent to which an intervention will be welcomed and viewed as necessary, safe and reasonable by the target population. The feasibility of water fluoridation will vary by country, depending on the availability of the required infrastructure. However, even with the available resources, fluoridation of water supplied is not viewed as acceptable by some groups in the population. Thus, from a political perspective, fluoridation of the water supply is not a straightforward decision. In contrast to North America and Australia, water fluoridation is not widespread in the UK. Just 10% of the population have access to a fluoridated water supply, with no coverage in either Wales or Scotland (British Water Fluoridation Society, 2012). Despite national guidance documents which acknowledge the evidence supporting water fluoridation (Chestnutt, 2013), it currently appears unlikely that the governments in Wales or

Scotland will introduce fluoride in to the water supply in the near future. The Welsh Government, for instance, have stated while they acknowledge that “water fluoridation has the potential to deliver significant health gains and address health inequalities”, they currently have “no plans to fluoridate water supplies in Wales” (Welsh Government, 2013).

2.4.3. Topical delivery of fluoride

In countries and communities without access to fluoridated water, fluoride exposure is largely dependent on its topical application. Much research has therefore been directed at finding effective and safe methods of applying fluoride topically.

Topical fluoride therapy refers to methods in which fluoride is applied directly to the surface of the teeth and the oral environment. Topical applications have far more concentrated levels of fluoride compared to the levels found in fluoridated water, and so are typically not designed to be ingested.

Professionally and self-applied topical fluoride

Some fluoride agents such as gels and varnishes typically rely on professional application. They differ from toothpaste in that they contain no abrasive ingredients, typically have a much higher fluoride concentration and they are therefore applied less frequently. Similarly, fluoride varnish is most often applied professionally, typically two to four times a year.

Self-applied forms of fluoride include fluoride mouthrinses and fluoride dentifrice or toothpaste.

Evidence

A series of systematic reviews by Marinho and colleagues considered the evidence base for the effectiveness of different topical fluoride methods for preventing caries in children (Marinho et al., 2003a, Marinho et al., 2003b, Marinho et al., 2003c, Marinho et al., 2013). They reviewed evidence from randomised and quasi-randomised clinical

trials which compared each of the fluoride therapies to placebo (or fluoride-free alternatives) and lasted at least a year in duration. Meta-analysis was carried out across studies in order to calculate the 'prevented fraction' (PF) of dmfs. The prevented fraction refers to the reduction in the proportion of decayed, missing or filled surfaces which could be attributed to in the intervention.

Table 2.2 shows a summary of the reviews and the estimated PF calculated from the meta-analysis. Overall, the reviews found good evidence that each of the delivery methods could deliver a reduction in caries prevalence when administered at the recommended dose. Importantly, they found that these benefits occurred irrespective of children's access to fluoridated water or other background sources of fluoride. It should be noted, however, that the vast majority of studies were conducted in relation to the permanent dentition.

Source	Fluoride method	No of studies considered (children)	Prevented Fraction, dmfs (95% CI)
Marinho et al, 2003	Fluoride toothpaste	70 (42,300)	24% (21% - 28%)
Marinho et al, 2003	Fluoride mouthrinse	34 (14,600)	26% (23% - 30%)
Marinho et al, 2003	Fluoride gel	25 (7,747)	28% (19% - 37%)
Marinho et al, 2013	Fluoride varnish	9 (2,709)	37% (24% - 51%)

Table 2.2: Summary of Cochrane systematic reviews of the anticaries effect of different topical fluoride delivery methods

Further reviews of studies directly comparing topical application methods concluded that there was no evidence that any one method was significantly more effective than any other, and that there was only a very small additive effect of combining methods with regular fluoride toothpaste, with the exception of fluoride varnish (Marinho et al., 2004a, Marinho et al., 2004b)

Feasibility and cost

Given that there is good evidence for the beneficial effects of each of these different methods of topical fluoride delivery, feasibility and cost are important considerations.

Gels and to some extent varnishes are less convenient and more costly, due to the need for professional application or at least close supervision. Fluoride gels in particular take a long time to administer and require fairly regular (monthly or bi-monthly) application to achieve significant caries reduction. Together with the significant risk of excess fluoride ingestion involved with their use, this mode of fluoride administration is now seldom used in the UK. In comparison, brushing with fluoride toothpaste is the most widely used and accepted form of topical fluoride delivery (Parnell and O'Mullane, 2013). The following section considers toothbrushing in more detail, including the numerous behavioural aspects which influence its efficacy.

2.4.4. Summary

The therapeutic effects of fluoride for protecting against caries development have been well documented. Its presence in the oral fluids helps to protect against demineralisation and promote remineralisation of tooth enamel. Fluoride therapy can take many forms, involving either systemic or topical delivery methods. In Wales (as with much of the UK), there is no fluoridation of the water supply, so the beneficial effects of fluoride are largely dependent on topical application of fluoride. This can involve professional applications such as gels and varnishes, but toothbrushing using fluoride toothpaste is by far the most common source of fluoride for the majority of the child population. The following section considers the evidence for the beneficial effects of brushing with fluoride toothpaste of different concentrations, and various behavioural factors which determine its efficacy.

2.5. Toothbrushing using fluoride toothpaste

In Wales, as with most of the UK, the absence of a fluoridated water supply means that toothbrushing with fluoride toothpaste represents the most common method of delivering fluoride to children.

While many modern toothpastes contain other active ingredients – including anti-plaque, anti-calculus and whitening agents – data prepared by the UK Medicines Information pharmacists suggest that the vast majority of available toothpastes in the United Kingdom contain fluoride as their main active ingredient (UK Medicines Information, 2012).

In terms of preventing caries, toothbrushing with fluoride toothpaste serves two purposes. Firstly, the mechanical act of brushing can serve to disturb the plaque biofilm which is implicated in both the development of caries and periodontal disease (Fejerskov and Kidd, 2008). However, the most important aspect of brushing with fluoride toothpaste is its use as a vehicle for topically delivering fluoride to the teeth and the oral environment.

Evidence

The evidence for the anticaries efficacy of toothbrushing with fluoride toothpaste in children is very strong. Marinho and colleagues conducted a systematic review of 74 randomised controlled trials which compared the use of fluoride toothpaste to placebo or non-fluoride toothpaste in children (Marinho et al., 2003c). They found an unequivocal benefit of fluoride toothpaste for reducing caries increments over the course of the trials, which ranged in duration from one to seven years. A meta-analysis of 70 of the studies showed that the use of fluoride toothpaste was associated with a 24% reduction in DMFS compared to control groups ($p < 0.0001$). Although trials specifically considering deciduous teeth were limited, they concluded that “the benefits of fluoride toothpastes are firmly established. Taken together, the trials are of relatively

high quality, and provide clear evidence that fluoride toothpastes are efficacious in preventing caries”.

Concentration of F

The available fluoride concentration in commercial toothpastes can vary, with concentration typically reported as parts-per-million (ppm). Evidence suggests that the concentration of available fluoride can be an important factor in determining the efficacy of toothpaste for preventing caries.

Walsh and colleagues conducted a systematic review of trials which compared the efficacy of toothpastes of different concentrations of fluoride (Walsh et al., 2010). As with the Marinho review, they used the ‘prevented fraction’ of DMFS as an outcome measure. They found that there was a statistically significant benefit of toothpastes containing at least 1000ppm fluoride compared to placebo (PF: 23%) and compared to toothpastes with only 250ppm fluoride. There was evidence of a dose-response effect, where increasing concentrations of fluoride (1700-2800 ppm) lead to better outcomes, but these were not statistically significant when compared with 1000ppm toothpaste.

Safety

The benefits of different concentrations of fluoride in toothpaste need to be considered in the context of the potential risks of fluoride ingestion, particularly in young children where there is an increased chance of swallowing toothpaste. A systematic review conducted by Wong and colleagues reviewed evidence for the effect of different concentrations of fluoride toothpaste for the risk of children developing fluorosis (Wong et al., 2010). They found weak evidence from two randomised controlled trials of an increased risk of mild fluorosis for children who used either 1450ppm or 1000ppm fluoride toothpaste compared to relatively low-fluoride comparisons (450ppm and 550ppm) for three to four years, but failed to find such any such association in cross-sectional studies.

2.5.1. Behavioural aspects of toothbrushing

In addition to the fluoride concentration available in toothpaste, there are various behavioural aspects of toothbrushing which can significantly impact on its anticaries benefits.

Rinsing

Given the topical action of fluoride in providing its anticaries effect, the extent to which fluoride is retained in the oral fluids after brushing is an important consideration. Duckworth and colleagues were able to show that the act of rinsing the mouth with water after brushing with fluoride toothpaste serves to decrease the concentration of fluoride in the saliva (Duckworth et al., 1991). Consistent with this finding, evidence from randomised control trials suggest that rinsing with large amounts of water after brushing can reduce the effectiveness of fluoride toothpaste for preventing caries, both in pre-school children (Sjogren et al., 1996) and school-aged children (Chestnutt et al., 1998). Consequently, guidelines suggest that children spit out excess toothpaste rather than rinsing with water after they finish brushing (Scottish Intercollegiate Network Guidelines, 2014, Public Health England, 2014).

Age that brushing begins and parental supervision

Cross-sectional studies suggest that children are at decreased risk of caries when parents report brushing their teeth before the age of 12 months (Pine et al., 2004a, Peres et al., 2009, Wong et al., 2012) or 24 months (Declerck et al., 2008). Guidelines generally advocate brushing children's teeth with a 'smear' of toothpaste as soon as the primary teeth erupt (Public Health England, 2014).

Parents are also advised to supervise their child's brushing until the child is at least seven years old. In theory, adult supervision serves numerous purposes: to ensure that toothbrushing is carried out regularly, to encourage good brushing technique and duration, to monitor the amount of toothpaste used and to ensure that children don't ingest large amount of the toothpaste (Davies et al., 2003). Cross-sectional studies

suggest that parental reports that they supervise their child's brushing are associated with a decreased risk of caries (Pine et al., 2004a, Rodrigues and Sheiham, 2000), though it should be noted that definitions of 'supervision' vary between studies.

Toothbrushing frequency

Perhaps the most important factor determining the efficacy of fluoride toothpaste for preventing caries is toothbrushing frequency.

The systematic review of fluoride toothpaste by Marinho and colleagues (Marinho et al., 2003c) investigated the caries-preventative effect of different frequencies of toothpaste use. They calculated that twice-daily use was associated with a 14% reduction in DMFS increment compared to brushing just once a day ($p < 0.0001$).

Numerous cross-sectional studies have also reported associations between parental reports of a child's brushing frequency and the child's caries levels. There is typically a reliance on parent self-reports of brushing behaviour, with the associated risk of recall or social desirability bias. With few exceptions (Finlayson et al., 2007), toothbrushing frequency has typically been measured and analysed at a categorical level rather than using continuous data. It is generally considered on a daily, rather than weekly or monthly basis. Comparing studies is made more difficult due to variations in the way that these categories have been applied and grouped: some studies compare "daily brushing" to "less than daily brushing" (Vanobbergen et al., 2001) while others report on "brushing twice a day" compared to "brushing less than twice a day" (de Silva-Sanigorski et al., 2013).

Despite these issues, there is evidence from such studies that the reported toothbrushing frequency of children is associated with decreased odds of children's decay experience. This has been reported for once-daily brushing compared to less often (Rodrigues and Sheiham, 2000, Douglass et al., 2001, Vanobbergen et al., 2001, Peres et al., 2005) and for twice-daily brushing compared to less than twice-daily brushing (Martens et al., 2004, Pine et al., 2004a, Stecksen-Blicks et al., 2004). The research by Pine and colleagues was an international, multi-centre study which

collected data from 2,822 children aged 3-4 from 17 different countries, comparing children who were 'caries free' with children with at least three decayed teeth. They found that a combination of children brushing twice daily, parents beginning brushing the child's teeth before 12 months and parents reporting regular supervision of their child's brushing doubled the odds of children being caries free (Pine et al., 2004a). It should be noted that some cross-sectional studies have, however, failed to find an independent relationship between reported toothbrushing frequency and young children's caries experience (Petersen et al., 2001, Southward et al., 2008, Elfrink et al., 2010).

Moreover, toothbrushing habits established in childhood set the foundation for good oral health later in childhood and adolescence when children begin to have some independence over the oral hygiene. A cohort study by Alm and colleagues found that children's toothbrushing frequency (as reported by parents) at three years old was predictive of caries experience at age fifteen. Those children whose parents reported brushing their teeth just once a day at home (compared to twice a day) at age 3 were twice as likely to have caries, and over four times as likely to have eight or more decayed or filled teeth, as measured radiographically. The authors concluded that "good oral hygiene habits, including the use of fluoride toothpaste, established in early childhood, provide a foundation for a low approximal caries prevalence in adolescence" (Alm et al., 2008).

Twice-daily toothbrushing is widely recommended (Public Health England, 2014, Scottish Intercollegiate Network Guidelines, 2014, American Academy of Paediatric Dentistry, 2014). In the UK, for instance, The British Association of Community Dentistry and the Department of Health recommend that children aged between 3 and 6 years old should "brush last thing at night and on one other occasion" every day (Public Health England, 2014).

Data on toothbrushing frequency in young children

The effectiveness of topically applied fluoride toothpaste in limiting caries development in children therefore relies on a parent or child's compliance in performing the behaviour regularly. Despite the widespread advocacy of the 'twice a day' toothbrushing message, epidemiological data suggest that a substantial proportion of parents of young children do not currently adhere to these guidelines.

Results from the 2003 Children's Dental Health survey in the UK showed that 21% of all children aged five had their teeth brushed either once a day or less often (White et al., 2006). There were significant differences in reported brushing frequency between parents from different social classes. The data showed that only 17% of parents from a relatively higher social class background (social class I-III) reported brushing their child's teeth once a day or less, compared to 36% of those parents from relatively lower social class backgrounds (social class IV-V).

A multi-site international study by Pine and colleagues also measured how often parents reported brushing five year-old children's teeth (Pine et al., 2004a). They found that anywhere between 68% and 15% of parents reported brushing their child's teeth less than twice a day, according to the country. Overall, socio-economic status was again a significant predictor of how often parents brushed their child's teeth.

2.5.2. Summary

The beneficial effects of toothbrushing with fluoride toothpaste for preventing caries in children are beyond doubt. However, these benefits are highly dependent on behavioural factors, including the frequency with which toothbrushing takes place. Evidence-based recommendations to brush children's teeth twice a day are widespread, but surveys suggest that many parents do not adhere to these guidelines. Non-adherence appears to be particularly high in more deprived communities.

Increasing the extent to which children's teeth are brushed with fluoride toothpaste should be considered an important goal for oral health promotion, then, and the following section considers different approaches to achieving this.

2.6. Interventions to increase children's toothbrushing frequency

Given that many parents brush their children's teeth less frequently than recommended, there have been numerous attempts to improve children's contact with topical fluoride.

2.6.1. Supervised toothbrushing schemes

One approach to improving the frequency with which children's teeth are brushed with fluoride toothpaste is to supplement home brushing with in-school, supervised toothbrushing.

Examples

Nursery and school-based toothbrushing schemes now feature prominently in the oral health strategies of national governments in Wales and Scotland. In Scotland, a nationwide nursery-school toothbrushing scheme called Childsmile has been in operation since 2006, expanding on previous national school-toothbrushing schemes. The scheme primarily involves nursery school staff supervising 3 and 4 year-old children toothbrushing in class every day, and there is very high coverage of the scheme across the country (Macpherson et al., 2010, Turner et al., 2010). This whole-population approach is complemented by additional elements of the Childsmile programme which are targeted in high-priority nurseries, include the provision of fluoride varnish application and help for families in registering with a dentist.

In Wales, a similar scheme called Designed to Smile has been in operation since 2010 (Designed to Smile, 2014), with daily supervised toothbrushing taking place in nursery-schools and primary schools for 3-6 year old children. In contrast to the universal coverage of nursery-schools in Scotland, the Welsh scheme is targeted on the basis of 'universal proportionalism' (Marmot and Bell, 2011) with coverage in most nursery-

schools and schools in relatively deprived areas of the country, and proportionally fewer nursery-schools and schools in less deprived areas.

Evidence

A number of randomised controlled trials of supervised school brushing schemes in relatively deprived areas of the UK have found reduced caries prevalence in young children who brush each day in school compared to control groups. Jackson and colleagues, for instance, reported a significant 10% reduction in caries increment among children who took part in a daily school brushing programme compared to a control group of children from the same community in London boroughs (Jackson et al., 2005). Curnow and colleagues found a greater reduction in caries increment – around 32% - for children who took part in a daily brushing scheme in Dundee compared to control groups (Curnow et al., 2002).

Significant improvements have been observed in dental caries prevalence and severity in representative samples of 5 year-old children in dental inspections in Scotland, since the beginning of the Childsmile scheme (Macpherson et al., 2013). The authors report a fall in mean dmft levels of five year-old children from 3.06 to 2.07 in a ten year period, with proportionally greater reductions in children from more deprived Health Boards. They were limited in their ability to link the improvements in oral health directly to the nursery brushing scheme, as individual-level data of scheme participation was not available for the children surveyed. However, they noted that the improvements to children's oral health occurred in a time frame which saw no such improvement to other indicators of child health, such as the proportion of children classified as overweight or the number of child hospital admissions (Macpherson et al., 2013). Overall, the data suggest that the Childsmile scheme has led to improvements in children's oral health and, importantly, a narrowing of oral health inequalities.

Limitations

School-based supervised toothbrushing schemes are not without their disadvantages, however. Setting up and administering such interventions requires significant time and

financial investment, with collaboration required from numerous stakeholders. Macpherson and colleagues listed 16 different stakeholders - ranging from children and families to schools, health bodies, government departments, academics, Information Technology staff, community and voluntary sector staff – who all contribute to the development and management of the toothbrushing programme in Scotland (Macpherson et al., 2010). Both Childsmile and Designed to Smile cost a significant amount of money to deliver each year, meaning that the schemes are reliant on ongoing political support and funding.

At an individual level, children will only take part in the supervised toothbrushing scheme for two to three years. The risk of dental caries persists over the entire life-course (Thomson et al., 2004, Broadbent et al., 2013) and the protective effects of fluoride therefore rely on regular exposure, in order to maintain its concentration in the oral environment (Featherstone, 1999). Learning to brush twice-daily in the home environment is therefore of utmost importance for children, in order that they can form life-long habits to minimise the risk of caries development into adolescence and adulthood.

Both Designed to Smile and Childsmile supplement the core toothbrushing element of the scheme with oral health promotion and education, links with health workers outside the immediate dental team and the provision of 'home packs' for children to regularly take home toothbrushes and toothpaste. They also aim to help families register with local dental practices. In this sense, they are essentially complex interventions, the inputs and objectives of which reach beyond the supervised toothbrushing and reduction in decay levels.

In theory, school toothbrushing programmes should provide excellent vehicles for promoting children's home toothbrushing frequency, given the access to large numbers of children and parents. However, the extent to which in-school brushing can promote sustainable improvements to children's toothbrushing behaviour in the separate home environment is currently not well understood.

A study by Wind and colleagues, conducted in Norway, found that children who took part in a supervised toothbrushing scheme in school brushed more often than a control group *during* the scheme, but one year afterwards, the differences in home toothbrushing frequency were no longer significant (Wind et al., 2005). It is difficult to generalise these findings beyond the specific toothbrushing programme utilised in Norway, but this study does illustrate that in-school brushing does not automatically translate to sustained improvements in home toothbrushing on its own.

2.6.2. Attempting to increase home toothbrushing

Another approach to improving children's contact with fluoride toothpaste is to try and increase home toothbrushing, through oral health education, advice or interventions aimed at changing people's behaviour.

However, oral health interventions have had limited success at changing people's long-term behaviour. A series of reviews conducted in the mid to late 1990s found no evidence that oral health education and promotion had any sustainable impact on children's oral health (Brown, 1994, Schou and Wight, 1994, Kay and Locker, 1996, Kay and Locker, 1998). In 1998, for instance, Kay and Locker conducted a systematic review of the effectiveness of oral health promotion schemes, concluding that there was no evidence base to suggest that such programs delivered sustainable improvements to oral health and oral health behaviour and that "oral health promotion and evaluation research needs to be improved" (Kay and Locker, 1998). Subsequent reviews focusing on interventions to improve oral hygiene and primary-school based interventions have also failed to find any evidence of sustained changes to oral health behaviour (Watt and Marinho, 2005, Cooper et al., 2013).

Some of the drawbacks of past efforts include targeting interventions at children rather than parents, a narrow focus on advice and education, and a lack of theory-driven work.

Aimed at children not parents

Davis and Bridgman reflect that oral health education has often been delivered in school settings and aimed primarily at children, with the joint aims of educating children about healthy and unhealthy food and highlighting the importance of regularly brushing their teeth. Such schemes have typically been supported by “workbooks, games, puppet shows, anatomical models, disclose and brush sessions and a wide variety of other innovative activities” (Davies and Bridgman, 2011).

One problem with oral health messages delivered in school settings is that young children rarely have much if any control over their oral hygiene routines during their formative years. Conceptual models of children’s oral health emphasise the central role that parents and families play in influencing children’s oral health (Fisher-Owens et al., 2007). In relation to toothbrushing, decisions about when and how often to brush teeth are likely to be made or at least highly influenced by parents or caregivers. To the extent that early childhood caries can be prevented by increasing toothbrushing frequency at home, it is parents and caregivers who need to be the main focus of any intervention.

Limitations of ‘oral health education’ alone

The Ottawa Charter for Health Promotion defines health promotion as “the process of enabling people to increase control over and to improve their health” (World Health Organization, 1986). From this perspective, health education is undoubtedly an important health promotion tool. Knowledge of the determinants of health and disease is an important pre-requisite for people to be empowered to make informed decisions about what is healthy or unhealthy behaviour.

However, a large body of research from the wider health literature suggests that providing people with knowledge of how they *should* behave is rarely sufficient to bring about long-term behaviour change on its own (Ogden, 2007). A Department of Health strategy document, ‘Healthy Lives, Healthy People’, reflects on the fact that most people are aware of government guidelines relating to how many portion of fruit and

vegetables they should eat and how much exercise they should take each day. Despite this, very few people act in accordance with such guidelines: only around 3 in 10 adults eat enough fruit and vegetables, and less than 4 in 10 adults report exercising as often as recommended (Department of Health, 2011).

In relation to toothbrushing behaviour, researchers have found similar discrepancies between parents' knowledge of how often they should brush their children's teeth and how often they actually report doing so. Blinkhorn, for example, gave questionnaire surveys to mothers of pre-school children and observed them brushing their child's teeth. He found that parents were knowledgeable about the need to brush their child's teeth twice a day, but concluded that "it is clear... that many parents know what should be done, but are either unable to do this, or for other reasons, do not practice what they know" (Blinkhorn et al., 2001). A more recent cross-sectional study carried out in Brazil by de Silva-Sanagorski and colleagues found no significant association between parental oral health knowledge and the frequency with which they reported brushing their child's teeth (de Silva-Sanigorski et al., 2013). A qualitative study by Daly and colleagues found that mothers of young children "felt that while they had the knowledge to prevent dental disease, the problem was translating that knowledge into actions to introduce positive oral health behaviours" (Daly et al., 2010).

Ultimately, while parents' knowledge of how often they *should* brush their children's teeth may be an important prerequisite to encouraging behaviour change, it is clearly not sufficient in itself. Oral health interventions which rely solely on providing best practice information to parents are unlikely to achieve long-term improvements to children's oral health.

Lack of theory-driven interventions

A major theme of each of the reviews of oral health promotion is that past interventions have generally had little theoretical underpinning and demonstrated a "failure to account for the wider determinants of health behaviour". A recent review of oral health interventions by Adair and colleagues reported that little had changed since the series

of critical reviews in the early 1990s, suggesting that “behavioural interventions for preventing dental caries in primary school children have not progressed at the same pace as behavioural science theory” (Adair et al., 2013).

2.6.3. Summary

National schemes such as Childsmile and Designed to Smile are aimed at supplementing home toothbrushing with in-school, supervised toothbrushing. While there are numerous advantages to these complex interventions, the supervised toothbrushing element is only temporary and the extent to which school-based brushing can improve children’s home toothbrushing behaviour is not well understood.

Promoting increased home toothbrushing through behaviour change interventions has proven very difficult. Systematic reviews point to numerous shortfalls in past interventions, including an over-reliance on an ‘education only’ approach and a tendency to target promotion efforts at children rather than parents. Perhaps the major criticism, however, is the fact that interventions have typically lacked any coherent theoretical framework.

In order that oral health education and behaviour change interventions can be more theory-driven, there first needs to be an understanding of the factors which influence parents’ decisions about how often to brush their child’s teeth at home. The following section considers some of the research that has been conducted looking at parental factors which are associated with children’s toothbrushing frequency, and identifies some of the gaps in the knowledge base.

2.7. Parental factors as determinants of children's toothbrushing frequency

Because young children have limited agency over toothbrushing frequency in the home, their dental health is highly influenced by the behaviour of their parents or caregivers. Innes and Evans make the point that “with regard to their oral health, children are extremely vulnerable, being entirely dependent on their parents/carers, who must take full responsibility for the child's oral health until the child is old enough to accept this responsibility for themselves” (Innes and Evans, 2013)

Understanding the various factors which influence parents' decisions about when and how often to brush their child's teeth is therefore a crucial starting point for designing effective oral health education messages and interventions. One of the major criticisms of past oral health education and promotion efforts has been a lack of theory-driven interventions. The previous section highlighted the mixed findings in relation to parents' oral health knowledge and their practices in terms of brushing their child's teeth. The current section considers other parental factors which have been explored in relation to children's toothbrushing frequency, and highlights areas which remain poorly understood.

2.7.1. Socio-demographic factors

As previously described, data from national and international surveys of children's toothbrushing frequency have reported that parents from relatively more deprived areas or lower 'social status' tend to report brushing their children's teeth less often at home (Pine et al., 2004a, White et al., 2006).

Other aspects of family composition have also been explored in relation to children's oral health. High birth order and larger family size have been associated with increased odds of caries experience in children (Hooley et al., 2012b), but very few studies have looked at toothbrushing behaviour specifically. One cross-sectional study from

Germany reported no significant effect of various family characteristics on toothbrushing frequency in children aged around ten years old (Listl, 2011).

2.7.2. Parents' own toothbrushing behaviour

Social Learning Theory (Bandura, 1977) suggests that people's patterns of behaviour are determined in large part by 'observational learning': by watching other people's actions and the outcomes of those actions. It might be expected, then, that children who observe their parents brushing their own teeth regularly will seek to copy this behaviour themselves: a process referred to as 'primary socialisation'. In addition, parents who brush their own teeth regularly might be assumed to have a more favourable attitude towards oral hygiene, and be more likely to initiate brushing their own child's teeth.

Various cross-sectional studies have reported significant associations between the oral hygiene practices of parents and their young children's oral health (Slade et al., 2006, Wigen and Wang, 2011). A study of 1,433 mothers of five-year old children in Finland, for instance, found that mothers' irregular toothbrushing was independently associated with an increased risk of their child having caries (OR: 1.5-2.2) (Mattila et al., 2000). Again, however, as the outcome measures used in these studies were oral health (measured by dmft), it is not clear whether this association is due to the child's oral hygiene practices or other factors, such as diet or even mother to child bacterial transmission.

A Scandinavian study looking at the toothbrushing behaviour of slightly older children (11-12 years old) found that children whose parents brushed infrequently (once a day or less) had increased odds of brushing their own teeth infrequently and consuming more sweets and sugary drinks (OR = 1.50) (Poutanen et al., 2007). Finally, a study of pre-school children in the United States found that mothers who brushed their own teeth before bed tended to brush their child's teeth more frequently in the course of a week (Finlayson et al., 2007)

2.7.3. Parental attitudes, beliefs and locus of control

The Health Belief Model and the Theory of Planned Behaviour

A number of 'socio-cognitive' theories and models have been proposed to explain people's health behaviour, and how these behaviours might be changed. Two of the most widely applied behaviour change theories in the field of health are the Health Belief Model (Rosenstock, 1974) and the Theory of Planned Behaviour (Ajzen, 1985). Central to both of these theories is the importance of people's attitudes and beliefs in determining their behaviour.

The Health Belief Model was initially developed by three American social psychologists in the 1950s, initially as a model to predict people's uptake of screening for tuberculosis. The model suggests that a person's likelihood of taking preventive action depends on the interaction of various beliefs:

- the perceived threat from the disease (based on the perceived susceptibility to the disease and the perceived severity or impact of the disease)
- the expectations associated with taking preventive action (based on the perceived barriers to taking action, alongside the perceived benefit of taking action on reducing the threat of a disease)

The Theory of Planned Behaviour was developed by Fishbein and Ajzen, as an extension of the earlier Theory of Reasoned Action. The model suggests that people form positive or negative intentions to behave in a certain way on the basis of their 'subjective norm', their 'perceived behavioural control' and their attitude towards the behaviour (Figure 2.8). This attitude is said to be based on their belief about the likely consequences of an action, and their desire to achieve those outcomes.

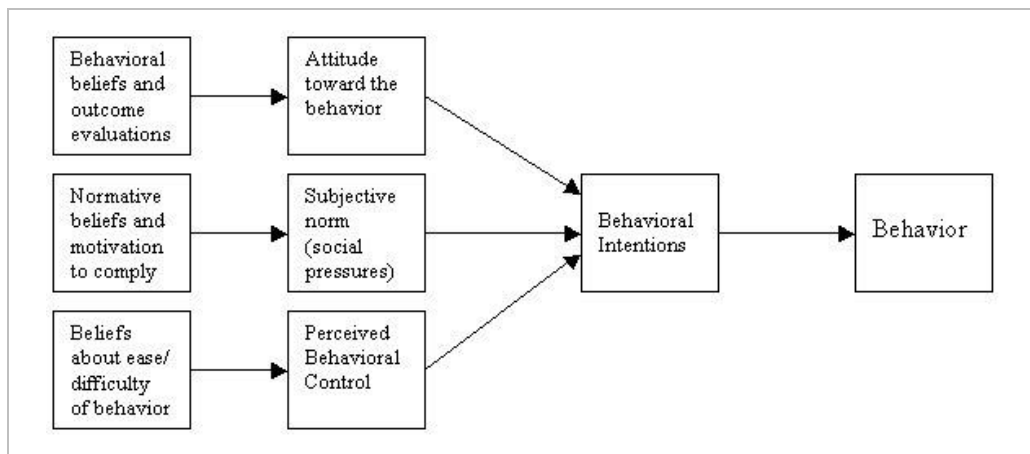


Figure 2.8: The Theory of Planned Behaviour, which suggests that attitudes and beliefs are important antecedents to behaviour

Together, these theories suggest that a parent will be more likely to brush their children’s teeth regularly if they believe that doing so will decrease the chance of their child developing tooth decay, if they believe that tooth decay would be unpleasant for their child, and if they believe that regular brushing will adequately reduce that risk.

There is, however, only a small body of research which has looked at parental attitudes and beliefs in relation to children’s toothbrushing.

Huebner and Riedy conducted interviews with 44 mothers in Washington State, asking about their experience of brushing children’s teeth at home. They reported a tendency among parents who brushed their child’s teeth less frequently to hold false beliefs about oral hygiene, including the perception that “if you brush more than you’re supposed to do, it picks off the enamel” (Huebner and Riedy, 2010). However, while they conducted some quantitative analysis, the generalizability of the results is limited by the small sample size.

A cross-sectional study in Iran, looking at slightly older children (9 year-olds), found that mothers who were rated as having a more positive attitude towards oral health were more likely to brush their child’s teeth at least twice per day (Saied-Moallemi et al., 2008).

However, other studies have found no significant relationship between parents’ attitudes towards oral health and their children’s toothbrushing frequency. Pine and

colleagues collected cross-sectional data from 2,822 parents of children aged 3-4 years old across 17 countries. They compared various parental characteristics to reports of how often they brushed their child's teeth, concluding that, of all the variables examined, "parents' attitudes towards prevention were least likely to predict the behaviour of twice daily brushing" (Pine et al., 2004b) More recently, Van den Branden and colleagues used the framework of the Theory of Planned Behaviour to investigate factors related to the frequency with which parents brushed their children's teeth, as well as their behaviour in terms of diet and dental attendance. They found that a more positive attitude towards oral hygiene was positively correlated with parents having a stronger *intention* to brush their child's teeth, but there was no relationship between a parent's attitudes and their actual behaviour (Van den Branden et al., 2013).

Polk and colleagues recently reported data from the Iowa Fluoride Study, showing that giving parents feedback about when their child had new caries failed to result in them brushing the child's teeth (or the child brushing their own teeth) more often (Polk et al., 2014). The results suggest that highlighting the consequences of failing to brush a child's teeth regularly may not be sufficient to change parents' subsequent behaviour.

Locus of control

A concept which is closely related to people's health-related beliefs is their 'locus of control': the extent to which a person broadly believes that their health (or their child's health) is determined by events over which they have personal control (an internal locus of control) or events over which they have little or no control (an external locus of control) (Wallston et al., 1976). While no studies have looked at a parent's locus of control and its effect on how often they brush their child's teeth, some research suggests that young children are more likely to experience caries if parents believe that their child's oral health is determined by events beyond their control (Lencova et al., 2008).

Overall, while there are theoretical reasons to believe that attitudes and beliefs might be important antecedents to parents' decisions about how often to brush their child's teeth, research in this area has been limited and reported mixed findings.

2.7.4. Parental self-efficacy

The concept of self-efficacy was developed by Bandura as part of his Social Cognitive Theory. It refers to "the belief in one's capabilities to organise and execute the sources of action required to manage prospective situations". Bandura argues that a person's self-efficacy is an important determinant of their health behaviour because "unless people believe they can produce desired effects by their actions, they have little incentive to act or to persevere in the face of difficulties" (Bandura, 2004)

An international cross-sectional study by Adair and colleagues gave questionnaires to 2,822 mothers of children aged 3-4 years old. They found that the most significant predictor of children's toothbrushing frequency was the parent's perception of their ability to control their child's toothbrushing habit (Adair et al., 2004). Similarly, Finlayson and colleagues developed an 'oral-health self-efficacy' measure for mothers of young children, asking them to rate how confident they would be of brushing their child's teeth in various unexpected circumstances. They found that oral-health self-efficacy was a significant predictor of children's weekly brushing frequency for both 2-3 year old and 4-5 year old children (Finlayson et al., 2007). Finally, a study carried out in Iran by Mohebbi and colleagues found that parents who believed they could 'make our child brush or clean their teeth twice per day' were more likely to report doing so (Mohebbi et al., 2008)

Qualitative research also points to parental self-efficacy as being a possible determinant of children's brushing behaviour. Amin and Harrison, for example, reported that parents of young children in Canada were generally very positive about wanting to brush their child's teeth, but often had little confidence in their ability to regularly carry out the behaviour (Amin and Harrison, 2009).

2.7.5. Sense of coherence

'Sense of coherence' (SOC) is a concept developed by an American sociologist named Aaron Antonovsky. Antonovsky was interested in understanding why some people are better able to cope with stress and 'stay well' (Antonovsky, 1993). He developed the SOC scale to measure an individual's disposition towards coping with stress, with higher scores relating to a greater 'sense of coherence'. The scale measures the extent to which a person feels able to cope with the demands and stresses of daily life ('manageability'), the extent to which they feel that events that occur in their life are rational and predictable ('comprehensibility') and the extent to which they view adversity as a challenge and worthy of engagement ('meaningfulness'). In this sense, there are crossovers with previously considered concepts such as self-efficacy and locus of control.

A number of studies have looked at sense of coherence in relation to oral health, primarily in adults and adolescents (Bernabe et al., 2009, Freire et al., 2001, Savolainen et al., 2009, Savolainen et al., 2005). One study conducted in Brazil reported that mothers with a relatively low sense of coherence were more likely to have children (aged five years old) with decayed teeth compared to those with high SOC scores (OR: 1.85) having controlled for social class and gender (Bonanato et al., 2009).

2.7.6. Summary

Parents or primary caregivers undoubtedly have a significant influence on their children's toothbrushing frequency in the home environment. Socio-demographic factors, and to some extent parents' own oral health practices have been linked to children's toothbrushing behaviour, but these factors are obviously difficult to change when thinking about interventions.

In comparison, there has been relatively little attention paid to the psychology of parents' decisions about how often to brush children's teeth. Indeed, recent national clinical guidelines published in Scotland (Scottish Intercollegiate Network Guidelines,

2014) considered a number of questions to be unanswered when assessing the evidence base for interventions aimed at improving children's oral health. Among them were: 'What personal or parental factors are associated with compliance with toothbrushing and dietary advice in children?' Parental factors such as attitudes, beliefs, self-efficacy and sense of coherence have been identified as potentially important variables, but the evidence is based on a fairly small number of cross-sectional studies.

Most research in this area has been guided by a relatively narrow set of behaviour change theories. The following section considers some of the limitations of these socio-cognitive behaviour change theories, and looks at why they may not be the most appropriate frameworks for understanding and trying to change oral health behaviour.

2.8. Beyond behaviour change theories

While behaviour change theories such as the Health Belief Model and the Theory of Planned Behaviour have been widely studied and applied to health behaviour, they are not without their problems (Ogden, 2003). The current section considers some of the more common criticisms of such theories.

2.8.1. Limitations of commonly applied behaviour change theories

The intention-behaviour gap

One of the central assumptions of models such as the Theory of Planned Behaviour is that people's behaviours are determined primarily by their intentions. Research shows, however, that people's intentions do not always predict how they will actually behave in the future. Webb and Sheeran, for instance, conducted a meta-analysis of 47 experimental studies in which researchers had demonstrated that they had modified people's behavioural intentions and then measured subsequent changes in behaviour. The studies they considered were primarily looking at health-related behaviours such as exercise, smoking, sunscreen use and the use of dental fluoride tablets. Meta-analysis showed that a medium to large change in a person's intentions lead only to a 'small to medium' change in their behaviour ($d = 0.36$, $r = 0.18$) (Webb and Sheeran, 2006). They concluded that their data indicated that "intentional control of behaviour is a great deal more limited than previously supposed". A subsequent meta-analysis of eleven experimental studies of physical activity found an even weaker relationship between intentions and behaviour ($d = 0.16$, $r = 0.07$) (Rhodes and Dickau, 2012).

This disparity between what people intend to do and what they actually do is sometimes referred to as the 'intention-behaviour gap' – the observation that people often behave in ways that run counter to their own stated goals and desires. This pattern of findings suggests that interventions based solely on socio-cognitive theories may often fail to change behaviour in the long term.

The assumption that behaviour is rational

"People often do things that they perceive to be good for them in the here-and-now, despite the potential for long-term harm; they refrain from doing "the right thing" even under circumstances where they know what "the right thing" is; they are tempted by rewards that are immediately available to the exclusion of greater rewards later in time. Indeed, self-defeating behavior is so ubiquitous that rationality in judgment and decision-making seems to be comparatively rare, and nowhere is this more apparent than in the domain of health behavior"

(Hall and Fong, 2003)

Both the Health Belief Model and Theory of Planned Behaviour are based on the concept of 'expectancy value theory' (Fishbein and Ajzen, 1975): they assume that people form behavioural intentions on the basis of a rational, calculated weighing up of the likely outcomes of performing that behaviour and their desire to achieve to them.

Researchers have, however, questioned the extent to which many day-to-day behaviours – including those which contribute towards health - are actually based on conscious, rational decisions (Hoffman, 2008). Dual-process models of human behaviour argue that our judgements, decisions and actions are determined by two separate, competing systems of information processing (Smith and DeCoster, 2000, Strack and Deutsch, 2004). The first system, a 'reflective' system, is said to guide action through a process of conscious forethought, whereby a person calculates the possible positive and negative consequences of an action and then forms an intention to behave in a certain way. Decisions made using this system of processing are said to be reasoned and goal-oriented, resulting in actions which appear rational. The second system, an "impulsive" system, is said to guide action through a more reflexive, stimulus-response type pathway, where behaviour is rapidly prompted by an object or event that activates some form of associative knowledge based on past experiences.

Theories such as the Theory of Planned Behaviour largely assume that behaviour is guided by the first, reflective system. In a paper entitled 'The Unbearable Automaticity of Being', Bargh and Chartrand advance the thesis that "most of a person's daily life is determined not by their conscious intentions and deliberate choices, but by mental processes that are put into motion by features of the environment and that operate outside of conscious awareness and guidance" (Bargh and Chartrand, 1999).

In the field of economics, Herbert Simon coined the term 'bounded rationality' to refer to the fact that people's decisions are often limited by constraints in available information, cognitive capacity and time. Rather than making optimal decisions, he argues that people tend to 'satisfice' – for instance, by selecting the first available choice that meets a basic requirement. Subsequent work by Kahneman and Tversky shows that decisions which are made impulsively often rely on 'judgement heuristics' – rules of thumb which reduce complex decisions to simple judgements (Tversky and Kahneman, 1974, Kahneman, 2003). These types of decision are said to result in 'cognitive biases' which can lead to apparently irrational decisions.

If people's decisions about how to act are often made using little conscious deliberation, socio-cognitive theories may have limited utility for understanding and changing some health-related behaviours.

Social and environmental factors

Socio-cognitive models of behaviour change have also been criticised for focusing too narrowly on individual factors, and failing to account for wider social and environmental factors which might influence or limit people's behaviour. Just as people's judgements and decisions may be bounded by cognitive limitations, researchers have argued that "people's behaviours are enmeshed within the social, economic and environmental conditions under which they are living" (Watt, 2005).

Ecological models and frameworks for understanding the determinants of health (Figure 2.9) highlight a range of different factors which can influence behaviour, ranging from wider socio-economic, cultural and environmental conditions, to more

immediate social and community networks (Dahlgren and Whitehead, 1991, Glanz et al., 2008).

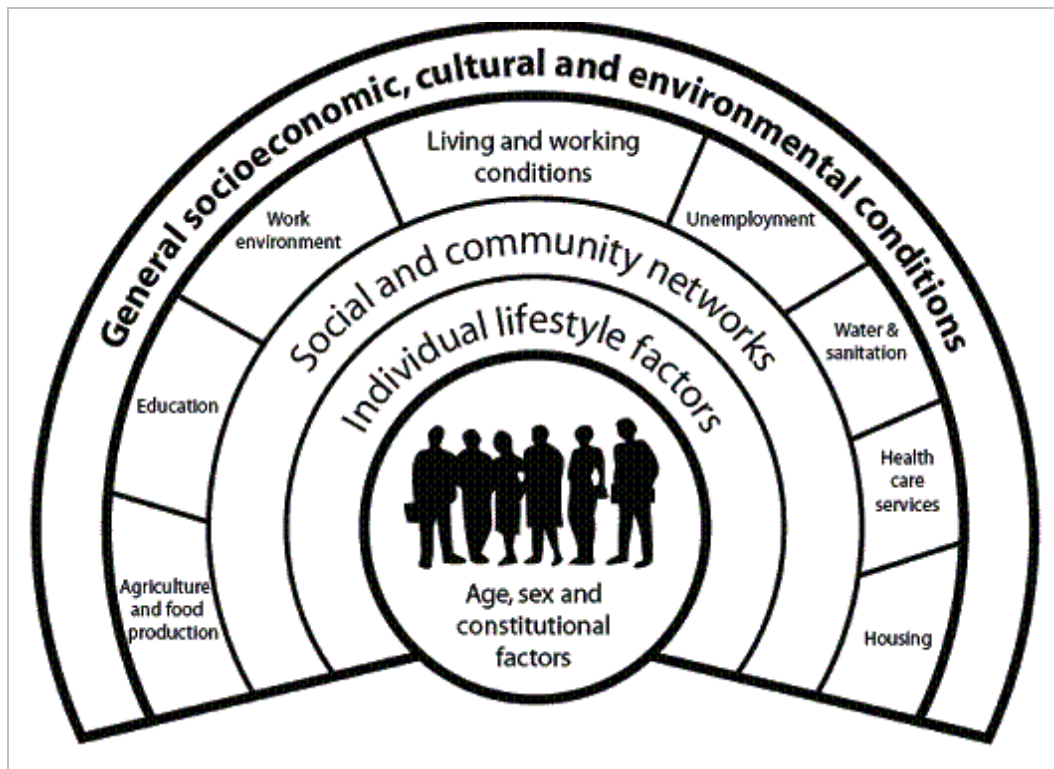


Figure 2.9: An ecological framework for understanding health behaviour, considering different levels of behavioural determinants. From Dahlgren and Whitehead (1991).

Research looking at dietary choice, for instance, suggests that a person's economic circumstances or the area and environment in which they live can have a dramatic effect on their food choices (Shepherd, 1999). Such studies show that practical factors such as affordability and accessibility can determine people's food choices as much as personal preferences.

2.8.2. New ideas and theories from the wider health literature

Given these considerations, there is perhaps a danger of relying on the same narrow group of theories of health behaviour change, at the cost of exploring new ideas from areas such as behavioural economics or sociology, or other novel concepts which may be specifically relevant to oral health or to certain high-risk populations. Indeed, Noar suggests that in oral health "we need more researchers to challenge existing theory, build new integrative theories, and bring new ideas into the fold (rather than simply

maintaining the status quo)... if we always develop our interventions from the same set of existing theories, we will never innovate in the ways that we should” (Noar, 2013).

2.8.3. Summary

While behaviour change theories such as the Theory of Planned Behaviour and Health Belief Model have been widely applied in many areas of health, they have a number of shortcomings which have been discussed above. Importantly, they have shown limited utility as theoretical frameworks for behaviour change interventions, both in oral health and the wider health literature.

It is therefore important to look beyond the same socio-cognitive theories and to generate new insights in to parents’ decisions about their child’s oral hygiene. The following sections consider ideas and concepts relating to behavioural decision making which draw from the wider health literature. They consider the way in which parents’ decisions might be influenced by wider social contexts, environmental factors and the role of ‘cognitive biases’.

The particular areas of focus in the following three chapters – social norms and comparisons, habits and routines, and short and long-term motivation – were guided by the findings from the first, qualitative study of this thesis. The results of that study are described in more detail in Chapter 4.

2.9. Social norms and social comparison

2.9.1. The social context of behavioural decision making

As previously described, health interventions based solely on a 'paternalistic' provision of expert advice and information are rarely successful in changing people's behaviour.

When people make choices to act in a healthy or unhealthy way, their decisions do not occur in a social vacuum. Ecological models highlight the importance of social and cultural factors in influencing people's decisions about how to behave (Glanz et al., 2008). Social influences can operate at a variety of levels, from the broader level of society through to local communities, peers and social networks.

One example of a social factor which has been studied in relation to health is the effect of 'social support'. This is the extent to which people are able to rely on family or close friends to provide practical or emotional assistance. Having better social support can act as a buffer against stress, which can affect people's health directly or serve to make it more difficult for them to make healthier lifestyle decisions (Wing and Jeffery, 1999).

2.9.2. Social norms

As well as offering support, other people can also act as a source of information on what sort of behaviour might be 'normal' or healthy. Social norms refer to "accepted standards of behaviour in social groups" which can provide a context in which individuals make decisions about their behaviour.

Perhaps the most commonly applied concept of norms in health research is the definition used in the influential Theory of Planned Behaviour. Here, a person's 'subjective norms' are said to be the product of beliefs about whether or not significant others want them to perform a behaviour (normative beliefs), and the extent to which a person wishes to comply with the expectations of others (motivation to comply) (Ajzen, 1991). This type of norm is commonly referred to in the literature as an 'injunctive

norm': a person's perception of what peers or significant others *think* they should do, where influence is exerted through a form of social pressure or expectation. Buunk-Werkhoven and colleagues (Buunk-Werkhoven et al., 2011), for instance, found a significant but weak relationship between individual's subjective norms and toothbrushing and flossing behaviour in a group of Dutch adults. Norms were conceptualised by asking participants whether or not friends, family or colleagues would "expect [me] to regularly brush or floss [my] teeth".

2.9.3. Descriptive norms

There is an important distinction in the literature between this type of injunctive norm and a second type of norm, called a 'descriptive norm' (Cialdini et al., 1990). Descriptive norms refer to a person's perception of what their peers *actually* do. Descriptive norms are typically assessed by asking a person to estimate how often they think a certain behaviour is carried out by an average or typical person in a given reference group.

Researchers have criticised theories such as the Theory of Planned Behaviour for incorporating a very narrow definition of norms (Rivis and Sheeran, 2003), focusing solely on injunctive norms and failing to acknowledge the separate and additive effect of descriptive norms. Meta-analysis shows that the social norms element of the theory is far weaker at predictive behaviour or intentions than a person's attitude or perceived behavioural control, finding that the addition of perceived descriptive norms adds significant predictive power (Rivis and Sheeran, 2003). Indeed, there is growing evidence from the wider health literature that perceptions of what others actually do may be a more important source of social influence than perceived social pressure (Sheeran and Orbell, 1999, Armitage and Conner, 2001, Fishbein and Ajzen, 2005, Rivis et al., 2006).

2.9.4. Perceived descriptive norms and behaviour

Recently, there has been a growing interest in exploring the extent to which people's health-related behaviour may be similarly influenced by what they believe other people do. Large-scale studies of college campuses in the United States have consistently shown that students' estimates of how often and how much their cohorts drink alcohol are the strongest predictors of their own alcohol consumption, more so than the actual reported behaviour of students on the campus (Larimer et al., 2004, Perkins et al., 2005, Miley and Frank, 2006). McAlaney and McMahon (McAlaney and McMahon, 2007) reported similar results with University students in the United Kingdom, finding a strong correlation between an individual's personal alcohol consumption and their beliefs about the level of alcohol consumption among their peers. Similar findings have been reported with regard to teenagers and students' smoking behaviour and dietary choices being influenced by the perceived behaviour of peers and parents (Lally et al., 2011a, Mercken et al., 2011)

As most research in this area is cross-sectional, the causal relationship between perceived norms and behaviour is not clear: a person's behaviour may be influenced by what they see as the norm, or they may use their own behaviour as a baseline against which to estimate what most other people do (Kypri and Langley, 2003). The former relationship – perceived norms influencing behaviour – is commonly inferred by researchers. In a study where the authors found a relationship between perceived descriptive norms and diet and exercise, for instance, Ball and colleagues concluded that "social norms may be potentially important determinants of physical activity and eating behaviors" (Ball et al., 2010).

The generalisability of the literature on the relationship between perceived descriptive norms and behaviour is also weakened by the fact that the vast majority of the research has been carried out with adolescents or students. There are theoretical reasons to believe that adolescents might be more influenced by their peers than older counterparts. Erikson's influential life-stages theory, for instance, suggests that

adolescence is a time of 'identity crisis' where young people are more susceptible to social influence (Erikson, 1959). The preponderance of studies focusing on young people means that research comparing normative influence between age groups is rare. However, a recent meta-analysis of health studies found a stronger relationship between descriptive norms and behavioural intentions in studies of younger people compared to studies involving older people (though both groups exhibited a significant relationship) (Rivis and Sheeran, 2003).

Nevertheless, numerous research studies show a normative influence on behaviour in older populations. Ball and colleagues (Ball et al., 2010) surveyed over 3,500 females from socioeconomically deprived areas in Melbourne, Australia, finding significant associations between perceived descriptive norms for fast-food consumption and exercise among reference groups and the participants' self-reported behaviour. Those women who thought others ate more fast-food tended to report higher fast-food consumption, for instance. Both seatbelt use and self-reported dangerous driving are also associated with perceptions of descriptive norms among peers (Forward, 2009). Hand washing frequency in both catering and hospital settings has been shown to be strongly associated with perceptions of how often colleagues carry out the behaviour (Snow et al., 2006, Clayton and Griffith, 2008).

Research looking at adherence to driving speed limits serves to illustrate how people's interpretation of guidelines, rules and laws can be modified by beliefs about how other people behave (Fuller *et al.*, 2008, Arthur, 2011). Fuller and colleagues, for instance, report a quote from a participant in a focus group who stated that they "used to drive 20(mph), but then I noticed that no-one else really does, so I started going a little bit faster" (Fuller *et al.*, 2008). Such findings have important implications for health promotion, suggesting that people's perceptions of what others do may well override prescriptive health advice or guidelines telling people what they *should* do.

Not all studies have found a relationship between perceived norms and behaviour: Stanton and colleagues, for instance, found that reported condom use among a group

of students in the United States showed no correlation with their perception of the prevalence of condom use among peers (Stanton et al., 1996). Other studies have reported only a weak correlation between perceived norms and behaviour in relation to diet and healthy eating (Povey et al., 2000, Åstr and Rise, 2001) and exercise (Chatzisarantis et al., 2007).

One potential explanation for conflicting evidence on normative influence is the lack of uniformity in the way that descriptive norms are measured. Both the conceptualisation of a descriptive norm and the reference groups used vary between studies. Some studies ask participants to state their level of agreement with a statement such as 'most of my peer group does activity X', others ask participants to estimate how many times an average person in their peer group might carry out an activity (Perkins, 2002b), while others ask what percentage of a person's peer group carry out the activity. Similarly, different studies have used different reference groups when asking participants to estimate descriptive norms: some explicitly refer to friends and family, others to peer groups or classmates, and others ask participants to make comparisons at an area or national level. These methodological differences are potentially important: there is evidence, for example, that more proximal peer group members exert more social influence on behaviour (LaBrie et al., 2010).

Overall, however, there is a growing body of evidence that people's health-related behaviours tend to be closely associated with their perception of what their peers do, even when these perceived norms contradict prescriptive rules or guidelines.

2.9.5. The accuracy of perceived descriptive norms

One of the most consistent findings in health-related studies of descriptive norms is that people tend to misperceive the prevalence of unhealthy behaviours among their peers. Surveys of students in the United States and Europe have frequently shown that the majority of individuals considerably over-estimate how often and how much their peers consume alcohol (Borsari and Carey, 2003, Perkins et al., 2005, McAlaney and

McMahon, 2007) compared to actual reported behaviour among the reference group. Similar results have been reported for over-estimates of the prevalence of smoking and substance use (Perkins and Craig, 2003, Haines et al., 2003). School children in the UK also over-estimate the extent to which their classmates consume fizzy drinks, while under-estimating their fruit and vegetable consumption (Lally et al., 2011a).

While most of the normative misperception research has been conducted with younger cohorts, one recent study suggests that this self-other discrepancy may exist for parents when comparing their childcare behaviour with their peers. Lally and colleagues surveyed over 400 parents of preschool children in the UK, asking them how often they gave their children 'unhealthy' snacks between meals, and how often they estimated that other parents did so. Parents estimated that over half of their peers gave their children unhealthy snacks at least daily, while only 10% reported doing so themselves (Lally et al., 2012)

Theoretical accounts attempting to explain apparent biases in self-other comparisons tend to fall in to two separate categories: motivational accounts or cognitive accounts.

Motivational accounts assume that people form positive self-other comparisons for reasons of self-enhancement or self-esteem: they are effectively motivated to view themselves in a positive light and so choose to see other people's behaviour as typically worse than theirs (Klein, 1997, Taylor and Brown, 1988). Cognitive accounts argue that misperceptions arise from "information biases" in processing social information (Kitts, 2003). One possibility, for instance, is that people see unhealthy behaviour like drinking alcohol or smoking as more salient, and so overestimate its occurrence in the wider population through a form of 'recall bias' (Perkins, 2002a).

Lastly, it may be that reported misperceptions are the result of methodological artefact: it may be that people's normative beliefs are actually accurate, but people are over or under-reporting their actual behaviour. While self-report data can certainly be subject to bias, research asking participants to estimate objective norms (such as the average Body Mass Index among peers) have also demonstrated similar misperceptions, with

participants typically over-estimating the average Body Mass Index of their peers (Maximova et al., 2008).

2.9.6. Norms-based interventions

The combination of these two factors – the idea that people's behaviour is associated with what they perceive others as doing, and that these perceptions are often inaccurate – has formed the basis of an increasing number of behaviour-change interventions which aim to provide people with more accurate normative information (Perkins, 2003).

Interventions based on this 'social norms approach' have been particularly common in American college campuses: a 2002 report by the Harvard School of Public Health found that almost half of 360 surveyed colleges in the United States had applied some form of normative intervention to address either alcohol consumption or wider substance misuse. These campaigns use either mass media campaigns or individual feedback to provide students with accurate normative data based on widespread self-report data. A typical message might inform students that "65% of students at this college drink fewer than four drinks when they party".

Research supporting the efficacy of such interventions has produced mixed results. Some researchers have found that social norms approach interventions have caused reductions in alcohol consumption (Haines et al., 2003) or smoking (Hancock et al., 2002) at a school or college level. Evidence from other areas suggests that presenting accurate normative information can result in net reductions in littering or towel re-use in hotels (Cialdini et al., 1990, Goldstein et al., 2008). Equally, however, there have been reports of social norms campaigns where research showed no substantive changes in behaviour (Thombs et al., 2004, Wechsler et al., 2003).

A Cochrane systematic review considering 22 reported college or school programmes concluded that web-based or face-to-face interventions delivering feedback on actual drinking norms appear to deliver moderate reductions in student drinking in both the

short and medium-to-long term (Moreira et al., 2009). At a wider health level, however, the variety of different approaches to delivering interventions and the different forms of evaluation used means that it is difficult to draw conclusions about the overall efficacy of interventions based on the social norms approach.

2.9.7. Social comparisons

Perceptions of social norms can also modify people's satisfaction with their own behaviour, or perception of risk through the process of 'social comparison'.

Social comparison is the process of comparing one's own behaviour with that of other people. It is considered a fundamental human social process (Festinger, 1954, Buunk and Gibbons, 2007) that plays an important part in almost all areas of human judgement (Mussweiler, 2003b). Research has consistently shown, for instance, that people's satisfaction with their salary or income is moderated by comparisons with a reference group: it is not the absolute value of a person's income that predicts how satisfied they are, but how well they feel their salary compares to their colleagues, peers or significant others (Brown et al., 2008).

Researchers in the field of body image and body satisfaction have found that people's judgement about their appearance tends to be highly influenced by comparisons with others (Jones, 2001, Blechert et al., 2009, Myers and Crowther, 2009). Similarly, people's perceptions of their risk or vulnerability to illness and disease also appear to be moderated by making social comparisons (Klein, 1997, Harris et al., 2002). One of the more striking examples of the effect of social comparisons on perceived health risk was a set of experiments carried out by Klein. Participants were informed of their risk of being involved in a car accident or contracting a fictitious disease (e.g., a 30% risk of being in an accident or contracting a disease) and the average risk for a person of their age and sex. He found that participants focused solely on the comparative information, to the point that people were more concerned if they were told they had a 30% risk of

being in an accident compared to an average person's 10% risk than they were if they were told they had a 50% compared to an average person's 60% (Klein, 1997).

Such findings have important implications for promoting behaviour change in health. Theories such as the Health Belief Model suggest that people's perceived susceptibility to a disease is one of the important determinants of their motivation to act in a healthy way. If the process of social comparison modifies this belief and people see their behaviour as 'normal' then there is less impetus for them to change. It suggests, again, that telling people what they *should* do may not be effective in itself. People may not judge their own behaviour in comparison to a prescriptive benchmark ("brush your teeth twice a day"), but in comparison to what they think most other people do.

2.9.8. Social norms and oral health

In the context of oral health, parents' perceptions of how often other parents brush their children's teeth may act as an important source of information.

Within oral health research, a small number of qualitative research studies have suggested that oral hygiene behaviour in adolescence may be influenced by peer groups and perceived group norms (Stokes et al., 2006, Hodge et al., 1983). An earlier study by Blinkhorn found that mothers of young children sought information about how to look after their child's teeth from close friends, family and dental professionals (Blinkhorn, 1978). However, there is an absence of research considering the way in which parents' perceptions of toothbrushing norms may affect how often they brush their own child's teeth.

2.9.9. Summary

In the wider health literature, there has been increasing interest in the role of social factors in influencing people's health-related behaviour. In fields such as alcohol, diet and exercise, researchers have found that people's perceptions of what their peers do appear to be strongly associated with their own behaviour and their satisfaction with

that behaviour. This information has provided the basis for 'social normative' interventions, which appear to be more successful than traditional educational approaches. The extent to which these perceived social norms might influence oral health decisions has not yet been explored.

In addition to the possible influence of cultural and social factors, people's decisions about health may also be affected by their environment. The following section considers how one environmental factor – the immediate home environment - might influence parental decisions about a child's oral health.

2.10. Habits, routines and the home environment

Just as people's decisions about health-related behaviour do not occur in a social vacuum, their decisions might also be influenced or constrained by the immediate environment in which they live. This section considers a person's home environment, and how the stability of a person's day-to-day home life can affect their ability to form or break 'habits'.

2.10.1. Behavioural control and repetition

An important factor when considering behaviour relating to health is that the positive or negative effect of certain actions – exercise, food choices, alcohol consumption, smoking and brushing teeth – depends on their frequency and repetition. Deciding to smoke one cigarette, eat one packet of sweets or take one exercise class may have a negligible effect on one's overall health, but when these things are repeated daily or weekly, they exert large cumulative effects.

When considering how best to persuade parents to brush their children's teeth at home, it is important to remember that most epidemiological studies suggest that almost all parents already perform this behaviour *to some extent*. That is, very few parents appear to neglect brushing their children's teeth altogether. Weinstein reflected on this when he suggested that "there is little recognition that oral self-care behaviours *already* exist" and that "in attempting to promote oral health, dental and medical professionals must be aware of the "fallacy of the empty vessel"... the disregard for the fact that clients already have established health customs" (Weinstein, 1986).

Promoting home toothbrushing may depend less on convincing parents to initiate the behaviour, then, and more on helping parents to establish a more predictable and regular routine of brushing their child's teeth twice each day.

2.10.2. The concept of habit

Until recently, habit was typically conceptualised as being a behaviour or action that a person had carried out regularly in the past (Ronis et al., 1989). Accordingly, researchers seeking to measure habit or habit strength would simply ask people how often they had carried out a certain behaviour 'in the last week' or 'the last year'. Other measures ask participants about habit more directly, requiring them to indicate how often they performed an action by 'force of habit' (Mittal, 1988).

However, a number of researchers have been critical of using behavioural frequency as a measure of habit (Ajzen, 2002, Verplanken et al., 2005). Ajzen, for instance, argues that past behavioural frequency is an 'experimentally empty concept' as it doesn't explain how or why a person behaved in a certain way, and is of limited use in designing interventions. Moreover, there is reason to believe that behavioural frequency and habit strength do not always go hand in hand. Verplanken argues that regularly behaving in a certain way does not always imply the formation of a habit, giving the example of a doctor who "may send numerous patients to the operation table, but this is (hopefully) not a habit, as each new patient requires a careful and deliberate decision" (Verplanken, 2006). Likewise, a person may have a 'habit' of visiting a favourite restaurant when they travel to a certain city, but only carry out this behaviour a couple of times each year .

2.10.3. Habits as automaticity

More recent theoretical accounts have argued that while repetition is important for habit formation, there are certain cognitive or mental elements of an action or behaviour which cause it to become 'habitual' (Wood et al., 2002, Verplanken, 2006).

Two important features of habitual behaviour are widely agreed upon: firstly, habitual behaviours are initiated automatically; and secondly, behaviour only becomes automatic when it is repeated in a stable, unvarying context. As habits develop over time, behaviour is said to become less conscious and more automatic (Aarts and

Dijksterhuis, 2000, Gardner, 2012). Bargh defines 'automaticity' as having four key features: low awareness, mental efficiency, difficulty to control and a lack of conscious intention (Bargh, 1994).

Low awareness and mental efficiency

In the aforementioned diary studies carried out by Wood and colleagues (Neal et al., 2006), participants were prompted each hour and asked to record both their actions and the thoughts and emotions that they experienced in the process. The researchers found that these repetitive behaviours were usually associated with thoughts that were unrelated to the action being performed, implying that participants were not necessarily concentrating on or aware of their behaviour. In contrast, participants carrying out novel actions usually reported thoughts that were directly related to their behaviour.

Similarly, automatic behaviour involves 'mental efficiency' - repeatedly acting in a certain way involves less conscious thought and so less cognitive effort. Lally and colleagues carried out interviews with several men and women who were attempting to make improvements to their diet and level of physical exercise over a number of weeks. The interviews showed that "the cognitive effort required to initiate new healthy behaviours gradually reduced and progressively less forethought was needed", with participants talking about dieting techniques eventually becoming 'second nature' and 'worming their way in to [my] head' (Lally et al., 2011b).

On the other hand, the low level of conscious awareness involved in automatic behaviour can lead to eating behaviour that is 'mindless' (Wansink, 2010) and not necessarily aligned to people's motives. Neal and colleagues devised an experimental study in which they gave participants a bag of either fresh or stale (one week old) popcorn to eat while they watched a film in the cinema (Neal et al., 2011). They divided participants into three groups (low, moderate, strong) according to the strength of their self-reported habit for eating popcorn when attending the cinema. In each group, those given stale popcorn rated it as tasting worse - yet for participants with strong habits, there was no difference in consumption between the fresh and stale group. In the

groups with weak or moderate habits, however, those given stale popcorn ate significantly less. The researchers interpreted the findings as showing that those with strong habits were eating the popcorn simply because that's what they usually did in that environment - not because they were motivated to do so by their enjoyment of the food.

Difficulty to control and lack of conscious awareness

Perhaps the most important consequence of behaviour becoming habitual and 'automatic' is that it becomes increasingly difficult to override or control, regardless of people's motives or intentions. Research from a number of topic areas has shown that habit strength is a stronger predictor of future behaviour than people's intentions, and that habit modifies the intention-behaviour relationship: people's intentions matter less and less for predicting their future behaviour when habit strength increases.

Ji Song and Wood, for instance, measured people's habit strength for eating fast food and watching TV (Ji and Wood, 2007). They asked participants to indicate how often they intended to perform these actions over the following two weeks, then later measured their actual behaviour. They found that intentions only predicted future behaviour for participants with weak or no habits - participants with strong habits continued to behave in the same way even when they intended not to. Similar results have been reported in prospective studies of people's transport choices (Klöckner et al., 2003, Fujii et al., 2001), condom use (Albarracín et al., 2004) and alcohol consumption (Gardner et al., 2012) and in meta-analyses of habit strength, intentions and behaviour (Webb and Sheeran, 2006, Ouellette and Wood, 1998).

Taken together, the 'automatic' qualities exhibited in habitual behaviour serve to illustrate why certain problem behaviours (unhealthy snacking, excessive alcohol consumption) can persist regardless of people's motivations, and often with little awareness (Wansink, 2010). When habits have developed over time, information campaigns designed to change people's attitudes and intentions may only have a limited effect on their long-term behaviour.

On the other hand, the same qualities serve to illustrate why habit development can be an important goal for certain positive health behaviours (Lally and Gardner, 2011). For instance, when regular exercise becomes habitual and so 'automatic', people are more likely to continue behaving that way despite daily fluctuations in motivation (Verplanken and Melkevik, 2008). Similarly, Loibl and colleagues argue that habit development can be important in personal finance because "habits of saving can reduce ad hoc rationalizations, hassles, and moods that may lead to the decision not to save money" (Loibl et al., 2011).

2.10.4. Measuring habits

In order to incorporate these cognitive elements of habitual behaviour, and to differentiate habit from past behavioural frequency alone, Verplanken and Orbell recently developed a multi-item measure called the Self-Report Habit Index (SRHI) (Verplanken and Orbell, 2003).

The twelve-item measure asks people to indicate their level of agreement with various statements. As well as including a measure of behavioural frequency ("Behaviour X is something I do frequently", "Behaviour X is something I have been doing for a long time"), it focuses for example on the extent to which the behaviour is automatic ("something I do automatically"), is done with minimum awareness ("something I do without thinking"), and would require conscious effort to override ("something I would find hard not to do").

The measure has shown good test-retest reliability and internal consistency (Verplanken and Orbell, 2003, Verplanken and Melkevik, 2008), correlates well with behavioural frequency measures but also offers discriminant validity over and above past behaviour in prospective studies predicting future behaviour (Verplanken and Melkevik, 2008). Both the authors of this tool and other researchers have used the SRHI to measure behavioural habituation in domains as such as travel choice, food and drink consumption, sunscreen use, seatbelt use and exercise behaviour (Allom et

al., 2013, Verhoeven et al., 2012, Gardner et al., 2012, De Bruijn, 2010). It is now the most commonly used tool for habit measurement. A meta-analysis of studies using the SRHI in exercise and nutrition research found a strong habit-behavioural relationship across 28 cross-sectional studies and, in eight out of nine prospective studies, habit strength modified the intention-behaviour relationship (whereby strong habits result in less influence of intentions on future behaviour).

2.10.5. Forming habits: the importance of routines and stability

A second principle of habit formation that is widely agreed upon is that repeated actions or behaviours only become automatic when they are performed in a stable, unvarying context (Ouellette and Wood, 1998, Sheeran et al., 2005, Verplanken, 2006). Wood and colleagues, for example, suggest that habit development requires actions that are performed "in particular locations, at specific times, in particular moods, and with or without certain interaction partners" (Wood et al., 2005). Contextual stability is important because it causes actions to gradually become associated with (and so eventually to become cued by) environmental stimuli, through the simple process of associative learning. If a person consistently drinks coffee with their breakfast every morning, for instance, the site of their breakfast cereal or bowl will eventually prompt them to begin their coffee making routine automatically, with minimal awareness or consideration of the merits or otherwise of coffee consumption. This is what Wood and Neal refer to as the "outsourcing of behavioural control to contextual cues", where these cues can include "certain physical settings, performance of a typically preceding behaviour or a person who is usually present" (Neal et al., 2006).

The extent to which a person's day-to-day life and environment is stable is therefore an important factor when considering both the disruption of unwanted habits and the formation of new, beneficial habits.

Two recent studies have looked at what happens to people's behaviour when they move to a completely new environment, and therefore no longer encounter the cues

that previously triggered their habits. Wood and colleagues studied a group of 115 American students who had transferred to a new University campus, assessing changes in their behaviours according to how different they felt their new environment was from their old one (Wood et al., 2005). Students with strong habits for exercising, for instance, exercised significantly less when they moved to a campus that was judged as being very different from their old one, whereas those who reported that their new campus was very similar continued to behave in the same way. They also found that intentions predicted behaviour more readily when context had been disrupted - people with a strong habit of watching TV who intended to cut down on their behaviour did so when they moved to a campus rated as being different, but failed to act on their intentions when their new campus was rated as being similar.

Verplanken and colleagues studied the effect of attitudes and habits on transport choices for commuting to work (Verplanken et al., 2008). They found that people's self-reported 'environmental concern' was associated with lower car use among those who had recently moved area (and so experienced disruption to their environment), but no relationship between transport choice and environmental concern was found for those who had been living at their address for over a year. The authors interpreted their findings as showing that "when context change disrupts individuals' habits, a window opens in which behaviour is more likely to be deliberately considered". In effect, taking away automatic cues to behaviour forces people to think about their actions and use the 'reflective' system of decision making in which their attitudes and beliefs exert a stronger influence. Deliberately altering aspects of a person's environment can therefore be an important intervention tool in breaking unwanted habits (Verplanken and Wood, 2006).

On the other hand, research suggests that the reverse situation is true when attempting to form a new habit: actions will only become automatic when they are consistently paired with the same set of stimuli, thus requiring a fairly stable environment (Lally and Gardner, 2011).

Qualitative research, for example, suggests that people attempting to eat more healthy meals are better able to sustain changes when in a predictable environment (their work office) than when their environment is disrupted (at the weekend, or when away on holiday) (Lally et al., 2011b).

2.10.6. The home environment, daily routines and contextual stability

As with toothbrushing frequency, medication adherence is an area in which regularly repeating behaviour is important for positive health outcomes. Successful management of a wide variety of chronic health conditions is dependent on a person remembering to take prescribed medication at regular intervals (Horne et al., 2005). However, studies utilising objective measurements such as electronic monitoring have shown that non-adherence (whether full or partial) is fairly common, particularly with children and adolescents, with up to 50% of people not taking their medication as prescribed (Sabate, 2003, DiMatteo, 2004). One of the most common reasons for non-adherence is simply 'forgetting' to take medicine (Sawyer and Fardy, 2003, Labig Jr et al., 2005).

Consistent with the central role of contextual stability in habit formation, researchers have found that the consistency of people's daily routines and home life can be an important predictor of their adherence to a regular medication regime. Qualitative studies show that taking medication is often embedded in (and so cued by) other home-based daily routines and activities such as waking-up, mealtimes, certain television programmes, personal hygiene behaviour and going to bed (Ryan and Wagner, 2003, Sanders and Van Oss, 2013). As a result, the degree to which these events occur regularly and predictably can be an important determinant of a person's medication adherence.

Wagner and Ryan studied a cohort of 51 HIV positive patients who had been told to take placebo pills every twelve hours in readiness for a course of antiretroviral treatment. Over two weeks, they measured how often participants took their medication and also measured the level of 'routinisation' of their daily activities by asking how often

they carried out certain behaviours such as sleeping at their own house, watching certain TV programmes and eating breakfast and dinner at home. They found adherence to be significantly better in those with more stable routines, concluding that “the extent to which one’s life is structured and routinized is an important factor in understanding medication adherence” (Wagner and Ryan, 2004).

Various measures of 'routinisation' have been employed by researchers in the field of medication adherence, reflecting the different elements of people's environment and routines that are of importance to the management of different diseases. Fiese and colleagues developed a multi-item 'Asthma Routines Questionnaire' which assesses the extent to which families had a 'set routine around when to take [asthma] medications' (Fiese et al., 2005). In a series of studies, they found that strong medication routines predicted better adherence in families with children aged between five and eighteen years old. A related but more exhaustive measurement tool is the 39-item Child Routines Questionnaire, which is completed by a child's parents and assesses the degree to which a child's daily activities follow a routine (Sytsma et al., 2001). Recent research suggests that children with more stable routines tend to show better adherence to medication used in the control of type-1 diabetes, and that stable routines can mediate the relationship between childhood behavioural problems and poor adherence (Greening et al., 2007). Research on sleep disorders tend to focus on the stability of children's bedtime routines (Hale et al., 2009) while the extent to which families have set mealtimes and eat together as a family is considered an important factor in research into childhood obesity (Fiese et al., 2012).

While the measurement tools used may differ, these studies collectively suggest that the stability of people's day-to-day routines and environment may play an important part in their ability to develop habits for health-related behaviour.

2.10.7. Habits, routines and oral health

Although routine stability was not measured directly, one recent study suggests that mealtime routines may have some influence on toothbrushing behaviour in adolescents. Levin and Currie carried out a secondary analysis of the Health Behaviour in School-aged Children survey, which collects data on various health and demographic details for Scottish children aged between 12 and 16. They found that regularly eating breakfast or evening meals at home was associated with increased odds of twice-daily toothbrushing (OR: 1.69, 95% CI: 1.49-1.93), even when controlling for socioeconomic factors (Levin and Currie, 2010).

Given the emphasis on repetition in relation to toothbrushing and oral hygiene regimes, it is perhaps surprising that more research has not considered its relation to other daily routines and events. Aunger acknowledged the idea of toothbrushing as a 'routinized' behaviour (Aunger, 2007), and earlier research by Croucher discussed the importance of considering toothbrushing as being influenced by people's daily schedules (Croucher, 1994).

A qualitative study by Cortes and colleagues reported that parents of young children (1-5 years old) often referred to the importance of routine and habits for establishing regular toothbrushing. They concluded that "the role of routines for proper oral hygiene offers great potential for influencing changes in health behaviours and practices" (Cortes et al., 2012).

Despite this interest, there have been no quantitative studies exploring the relationship between habits, routines and the frequency with which young children brush their teeth at home.

2.10.8. Summary

The concept of habit has received growing interest in understanding repeated health behaviour, whether harmful or positive. Developing an automatic habit is associated with more frequent and consistent behaviour in areas such as exercise, and predicts

future behaviour more reliably than people's intentions. Despite the 'routinised' nature of toothbrushing, and the recommendation to brush twice every day, the concept of habit has yet to be explored in relation to oral hygiene behaviour. The literature suggesting that habit development requires repetition of behaviour in a consistent environment suggests that the day-to-day stability of children's home environments may play an important part in influencing toothbrushing behaviour.

In addition to social and environmental factors as possible determinants of health behaviour, research suggests that people's cognitive biases may influence health decisions. The following section considers the importance of one aspect of cognitive bias: the motivation or rationale that people have for behaving in a certain way, and how this might be affected by a tendency to focus on short-term, rather than long-term outcomes.

2.11. Motivation and cognitive biases

A parent's motivation for brushing their children's teeth is an important consideration for designing effective and persuasive oral health messages. Given the recommendation for twice-daily brushing, it is particularly important to understand what parents see as the benefits of brushing their child's teeth at different times of day.

This section explores the wide range of factors that might motivate people to behave in a healthy or unhealthy way, and considers how one common form of 'cognitive bias' can make it difficult to promote actions which require short-term discomfort in exchange for long-term benefits.

Motivation for healthy behaviour – beyond reducing risk of disease

Theories of health behaviour such as the Health Belief Model assume that people are largely motivated by the desire to reduce their risk of various diseases. This emphasis on disease and reducing risk is echoed in the sort of messages that practitioners might typically provide to people when encouraging them to modify their health-related behaviour.

This focus on disease, however, is a fairly restrictive view of what motivates people's health-related behaviour. Research looking at why people take up exercise or take part in sports suggests a wide range of motivating factors. Some people exercise to improve their appearance, other people exercise because they enjoy the way it feels, while others may exercise primarily because they enjoy the social experience (Teixeira et al., 2012, McArthur et al., 2014). Likewise, research shows that people often report giving up smoking or drink less alcohol for financial reasons, rather than because of health concerns (Shaw et al., 2011).

2.11.1. Toothpaste composition and the benefits of brushing

While fluoride toothpaste may confer most of its benefits as a vehicle for topical fluoride delivery, modern toothpastes are clearly designed to appeal to more than just long-term health concerns.

In discussing the wide range of ingredients in fluoride toothpaste, Sanz *et al.* consider that “modern toothpastes have both cosmetic and therapeutic objectives: to help the toothbrush in cleaning the tooth surface and providing fresh breath (cosmetic) and to provide a therapeutic effect, mainly through anti-caries, antihalitosis, antiplaque or anti-inflammatory effects” (Sanz et al., 2013)

While clinicians may tend to emphasise the importance of toothbrushing for its effect on reducing the risk of dental caries or periodontitis, toothpaste manufacturers have often marketed their product to appeal to a more immediate sense of hygiene and ‘fresh breath’. A recent paper by van Loveren and Duckworth points to an increasing interest in recent years in formulating toothpastes with whitening and anti-calculus properties (van Loveren and Duckworth, 2013).

2.11.2. Motivation and oral health

Given the composition of modern toothpastes, it is likely that people are motivated to brush their teeth, or their children’s teeth, for reasons which range from being immediate and short-term (cosmetic) to delayed and long-term (reduced risk of future disease).

Studies considering individual motivation for toothbrushing are relatively rare, however, and have focused largely on adolescents. MacGregor and colleagues reported data from a large survey of 14-15 year old children in the United Kingdom, which showed that most brushed in the morning (75%) but very few brushed in the evening (23%). They found that those who brushed less often were “motivated more by social reasons than by preventive dental health factors” (Macgregor et al., 1996). Other qualitative work has pointed to a similar tendency to emphasise social and cosmetic factors when

considering the reasons for brushing teeth (Rajala et al., 1980, Hodge et al., 1983, Dorri et al., 2009).

Most of this work has been carried out with adolescents, however, and it may be that cosmetic considerations are more important to this age group than to others. To date, no research has attempted to quantitatively measure toothbrushing motivation or considered the factors which might motivate parents to brush their child's teeth at different times of day.

2.11.3. Short-term and long-term benefits – cognitive biases

Behaviour change interventions aimed at promoting healthy behaviour often involve convincing people to forego short-term benefits (or to experience short-term discomfort) in order to achieve long-term benefits to their health, through reducing the risk of disease or illness. However, this sort of trade-off runs counter to people's natural tendency or bias towards short-term rather than long-term rewards and benefits.

Conditioning and reinforcement

Previous sections considered the idea that theories of health behaviour such as the Health Belief Model and Theory of Planned Behaviour are based on the idea that people weigh up the likely pros and cons of behaving in certain ways, in an apparently rational manner. However, one area in which people's weighing up of consequences may not be entirely rational is with regard to the time course of the perceived rewards or benefits.

Behaviour analysis is a school of thought based on the work of 'behaviourism'. This approach argues that people's behaviour is largely determined by past experience and learning. It suggests that people are less likely to perform actions which they have previously been 'punished' for, but more likely to perform actions for which they have previously received "reinforcement" or rewards. One clear pattern of findings within this field of research is that actions tend to be reinforced more strongly if the rewards are immediate, rather than delayed. What this means is that rewards which occur

immediately – for instance, the enjoyment from eating chocolate – can often be more influential in determining behaviour than rewards which occur in the future such as good health in older age.

Temporal discounting

Research from the field of behavioural economics suggests that people often inform their decisions through attending to more immediate outcomes and discount the importance of delayed outcomes even when the value of these delayed outcomes is significantly greater (Frederick et al., 2002). This cognitive bias is sometimes referred to as ‘delay discounting’ or ‘myopia’.

Delay discounting is often measured using variations of a ‘Money Choice Questionnaire’ (Kirby and Marakovic, 1996), where people are offered an immediate reward (for example £50) or a larger, future reward (for example, £100 in 5 years). Typically, people choose the more immediate reward, but there is also considerable variation in the extent with which people place importance on immediate and delayed outcomes: some people are more myopic than others (Reynolds, 2006).

There is some debate as to whether a person’s tendency to discount future monetary rewards reflects a stable personality trait or a temporary reflection of circumstances (Kirby, 2009). There is evidence, for instance, that discounting tends to be higher among people from low-SES backgrounds (Nurmi, 1987).

Similarly, there has been some disagreement about the extent to which people’s tendency to discount future benefits in financial terms can be related to their decisions in other fields such as health. However, high levels of discounting are implicated in addictive behaviours such as smoking and heavy alcohol consumption. One cross-sectional study by Bradford carried out in the United States reported an association between people’s monetary discounting tendency and their engagement in certain ‘health protective’ behaviours such as taking regular exercise or voluntary flu vaccinations (Bradford, 2010).

2.11.4. Summary

While many theories of health behaviour assume that people are motivated to minimise the risk of disease, research from a variety of fields suggests that people's health-related behaviour is motivated by many different factors. There is a particular tendency for people to prefer short-term benefits over longer-term benefits, and this cognitive bias may have implications for designing health education messages. While there is some evidence that adolescents are often motivated to brush their teeth with consideration for their physical appearance, the reasons that parents are motivated to brush their young children's teeth have not been fully explored.

2.12. Chapter summary

This review of the literature highlights the fact that dental caries remains a problem for many children in industrialised countries, and that its impact on children's wellbeing and quality of life can be significant. The review deliberately takes a wider focus on the aetiology and determinants of dental caries in children, in order to acknowledge that toothbrushing frequency is only one part of a larger picture. Nevertheless, there is strong evidence that the frequency with which children's teeth are brushed with fluoride toothpaste does make an important contribution to the chances that they will develop dental caries. However, current evidence suggests that many children – particularly those in deprived communities – do not currently have their teeth brushed twice a day.

Given that children are highly dependent on their parents or caregivers for establishing toothbrushing frequency, it is important to understand why parents do or don't brush their child's teeth at home. In the past, oral health interventions have failed to bring about sustainable changes to people's oral health behaviour. However, a better understanding of the factors which influence oral health decisions might provide a framework for designing more persuasive messages, or more theory-driven interventions.

To date, much oral health education and research considering parental influences on children's oral health has focused heavily on knowledge, attitudes and beliefs. While these may be important pre-requisites to determining parent's behaviour, evidence suggests that focusing on these factors is not enough to change behaviour in the long-term.

The review therefore highlights some gaps in the current understanding of how parents make decisions about brushing children's teeth at home. These include:

- A lack of research which looks at the way in which social factors may influence low-SES parents' decisions about when and how often to brush their child's teeth at home.

- A lack of research which looks at the way in which the home environment might influence low-SES parents' decisions about when and how often to brush their child's teeth at home.
- A lack of research in to the way in which cognitive biases might influence low-SES parents' decisions about when and how often to brush their child's teeth at home.
- An absence of theoretical frameworks which might inform and underpin interventions aimed at increasing the frequency with which some low-SES parents brush their child's teeth at home.

The following chapter looks at the aims of the current study, which were developed to address some of these knowledge gaps.

3. AIMS AND OVERVIEW OF METHODS

3.1. Aims

The primary aim of this work was:

- *To explore the way in which wider social, environmental and cognitive factors might influence parents' decisions about when and how often they brush their children's teeth at home, in order to inform future oral health advice aimed at parents and identify relevant theoretical frameworks for behaviour change interventions*

This aim was broken down in to three secondary aims, which were:

- *To identify social, environmental and cognitive factors which influence parents' decisions about when and how often they brush their child's teeth at home*
- *To measure these factors and determine how they relate to the frequency with which parents brush their child's teeth at different times of day*
- *To explore one of these factors in more depth, in order to identify possible mechanisms for changing parents' behaviour through oral health advice and intervention*

3.2. The study population

The participants in each of the three studies were parents of children who were taking part in the Designed to Smile toothbrushing programme in South-East Wales, whose children were aged between 3-6 years old.

More detail about the participants, and the sampling and recruitment techniques are given in the individual study chapters which follow. This section briefly considers the reasons for choosing this broad cohort of parents for the project's study population.

3.2.1. Designed to Smile participation

The decision to recruit parents whose children took part in the Designed to Smile scheme was taken from both a pragmatic point of view, and because their socio-economic profile was consistent with the study's aim to focus on parents from deprived communities.

An important consideration in choosing to recruit parents whose children were taking part in the Designed to Smile scheme was that it allowed for better access to parents. The researcher already had experience of working with Community Dental Service staff through the process evaluation of the scheme. In South Wales, staff from the Community Dental Service have established good relationships with school staff and parents through years of partnership work. Throughout the project, they aided recruitment by distributing information sheets and consent forms to school teachers, who in turn gave these forms to parents and children. They also encouraged parents to take part in the studies during events such as the Designed to Smile parent talks. This sort of link was an important consideration for conducting research in deprived communities, where recruiting participants to studies can be particularly challenging.

The second reason for choosing to recruit from Designed to Smile schools was that children's participation in the scheme acts as a proxy for socio-economic deprivation. Designed to Smile is deliberately targeted at schools in areas of high deprivation, using data from the Welsh Government's Welsh Index of Multiple Deprivation (WIMD), which

ranks geographical areas as more or less deprived according to various social, environmental and economic factors. As nursery and primary schools in Wales only take in children from surrounding 'catchment areas', the parents of children who attend these schools are invariably living in areas classified as socio-economically deprived. Recruiting from Designed to Smile schools was therefore consistent with the project's focus on parents from deprived communities.

3.2.2. Parents of young children

The Designed to Smile scheme operates in nursery and primary schools and involves children who are very young (6 months and above), as well as older children aged 7-8 years old. For the purpose of the current study, a decision was made to limit the study to parents whose children were aged between 3-6 years old. This decision was made for two reasons.

Firstly, as the primary aim of the study was to understand parental influences on children's brushing habits, it was felt that children older than six years old would be more likely to have some independence about when and how often they brushed their own teeth. A number of national clinical guidelines, for instance, recommend that parents supervise their child's brushing until they turn seven (Scottish Intercollegiate Guidelines Network, 2014). At six years old or younger, children are likely to be largely dependent on their parents to instigate and monitor their toothbrushing behaviour.

Secondly, it was felt that parents' decisions about when and how often to brush the teeth of very young children (0-2 years old) were likely to be somewhat different to decisions made about children aged 3-6 years old. Such decisions will likely be influenced by factors such as beliefs about what is an appropriate age to commence brushing a child's teeth. While this is undoubtedly an important area of research, it was decided that this was beyond the scope of the current project.

3.3. Mixed-methods approach

This PhD project used a ‘mixed-methods’ research approach to address the research aims. It comprised three studies which make up a single project: one qualitative, and two quantitative.

The methodological approach taken for each of the three studies is detailed in the individual study chapters which follow. This section considers the reason that an overall mixed-methods approach was considered appropriate to address the project’s aims, and looks at the way in which the three studies were combined.

3.3.1. Why use a mixed methods approach?

Mixed-methods research refers to “the class of research where the researcher mixes or combines qualitative and quantitative research techniques, methods, approaches, concepts or language in to a single study” (Johnson and Onwuegbuzie, 2004).

A mixed-methods project recognises that qualitative and quantitative research techniques have different strengths and weaknesses, and that their different philosophical assumptions mean that certain types of research questions are best answered by qualitative research methods, while others are best answered with quantitative methods.

Qualitative and quantitative research approaches

One area in which quantitative and qualitative research approaches differ is epistemology. Epistemology refers to theories and beliefs about how we learn things about the world and how we have faith in the validity of that knowledge. Quantitative research is typically associated with a positivist approach. A positivist position assumes that knowledge can only be generated by that which is observable and can be scientifically verified. It is therefore associated with research questions concerned with measuring how many people have a certain health condition, or behave in a certain way. Qualitative research, on the other hand, is typically associated with an

interpretative approach. Interpretative research is focused on exploring people's experiences of a health condition, or the underlying reasons that they might behave in a certain way. It is, according to Pope and Mays, "concerned with the meanings people attach to their experiences of the world and how they make sense of that world" (Pope and Mays, 2013). For this reason, qualitative research is often seen as "giving a voice" to the participants (Hennink et al., 2010).

A second key difference between qualitative and quantitative research is the way in which theory is generated and tested. Quantitative research is often associated with the use of a *deductive* approach. Here, an existing theory or hypothesis is used as a starting point, with the research designed to answer a specific question. Qualitative research, on the other hand, is often associated with the use of an *inductive* approach. Here, the goal is typically to generate new ideas, theories or hypotheses which are grounded in the data.

By combining the two approaches, it is possible to answer complex research aims and questions more comprehensively, and to 'offset' the weaknesses of the two approaches while utilising their strengths (Bryman, 2006). Indeed, Creswell considers that the "core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone" (Creswell, 2003).

3.3.2. Overview of the project design

There are a number of different ways of combining qualitative and quantitative research methods within a single project (Johnson *et al.*, 2007), and the choice of approach depends on the aim of the study. Table 3.1 summarises some of the more common mixed method research designs.

Research design	Summary
Convergent parallel design	QUAN and QUAL carried out at same time
Explanatory sequential design	QUAN followed by QUAL
Exploratory sequential design	QUAL followed by QUAN

Table 3.1: Summary of three commonly employed mixed-method approaches

The research design of the current project most closely mirrored the ‘exploratory sequential design’. In this approach, an initial qualitative study is followed by a quantitative study (or series of quantitative studies). The sequential approach means that the data collection and analysis of the initial qualitative study is completed prior to the design and conduct of the second, quantitative study. In the current project, the findings from the second study then lead to the design of a third, experimental study (Figure 3.1).

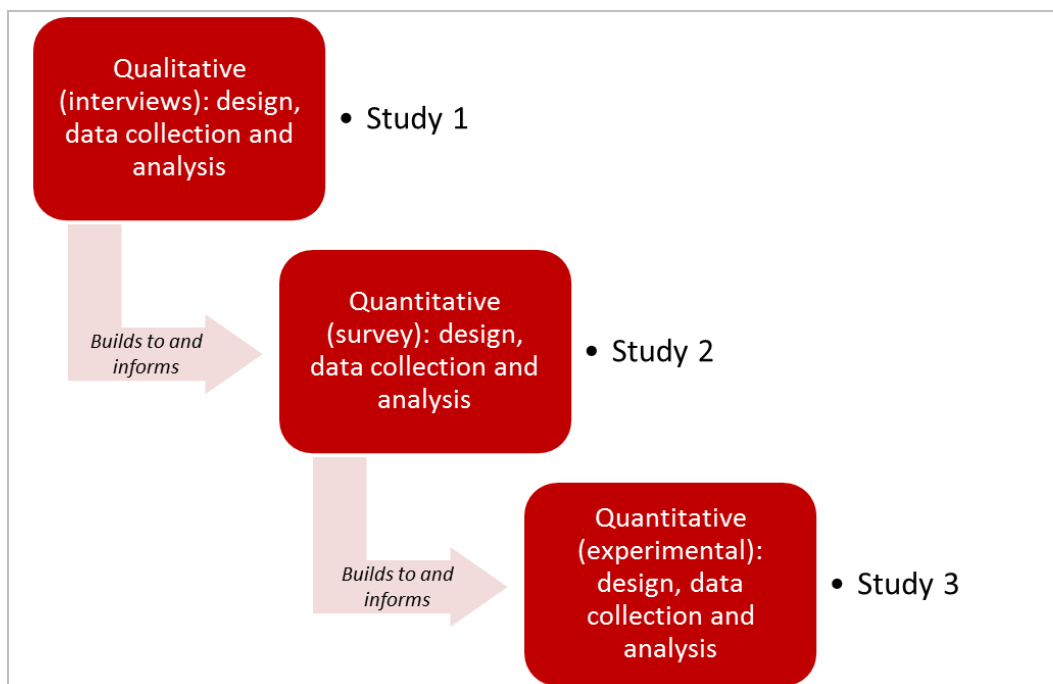


Figure 3.1: Summary of the mixed-methods approach employed in the current project

Carrying out two or more studies sequentially naturally takes longer than running studies concurrently. However, this sequential approach means that the ideas and concepts developed from an initial qualitative study can be used to inform the development and the materials used in a subsequent quantitative study (Cresswell and

Plano Clark, 2011). Such an approach is useful when there is only a limited amount of knowledge about a subject. Using relatively open-ended questioning, a qualitative study can be used to explore a topic and generate ideas and concepts, the results of which can then inform the design of a questionnaire survey, or another quantitative research approach (Onwuegbuzie *et al.*, 2010).

The research design was also *emergent*: that is, the methods and the materials were developed throughout the study (Creswell and Plano Clark, 2011). While there was a broad plan to follow the initial qualitative study with some quantitative work, the design of the two quantitative studies in the current project were entirely informed by the findings of the first, qualitative study.

Bryman suggests that researchers conducting mixed-methods projects should give consideration to whether the qualitative or quantitative part of the work is given priority (Bryman, 2006). In keeping with the emergent nature of the research design, neither the qualitative or quantitative approaches was given priority in the current project. Instead, the different methodologies were employed to best answer the study's various research aims. While the results of each study are reported and discussed in separate chapters, the General Discussion chapter (Chapter 7) synthesises the findings from each study in order to draw overall conclusions.

Table 3.2 summarises the three different studies carried out in this project, as well as their aims and a summary of the methods employed.

Study	Study aim	Summary of methods
Study 1	To identify factors which influence parents' decisions about when and how often they brush their child's teeth at home	Qualitative: Semi-structured telephone interviews with parents of children aged 3-6 (n=15)
Study 2	To measure the factors identified in Study 1 and determine how they relate to the frequency with which parents brush their child's teeth at different times of day	Quantitative: Self-complete postal survey of parents of children aged 3-6 (n=297)
Study 3	To explore in more depth one of the factors identified in Study 1 and Study 2, in order to identify possible mechanisms for changing parents' behaviour through oral health education or interventions	Quantitative: Experimental design, parents of children aged 3-6 (n=120) completing six page exercise sheet in presence of researcher

Table 3.2: Summary of the three studies used in the current project

4. STUDY 1 – PARENT INTERVIEWS

This chapter describes the first study of the PhD project. The study consisted of a set of in-depth interviews with fifteen parents of children aged between three and six years old and was conducted to explore the factors that influenced their decisions about when and how often to brush their child's teeth at home.

The *introduction* (Section 4.1) briefly reflects on some of the findings from the literature review, and explains how certain gaps in the knowledge base lead to the development of this first qualitative study. The *methods* section (Section 4.2) describes the study population, and the approach to data collection and analysis. The *results* section (Section 4.3) describes the main themes and sub-themes generated from the study, and presents illustrative quotations from the participants. Finally, the *discussion* section (Section 4.4) considers the key findings in relation to the existing literature, and reflects on some of the limitations of the study.

A manuscript based on this study was published in the *International Journal of Paediatric Dentistry* (Trubey et al., 2014). The article is presented as Appendix 9.

4.1. Introduction

4.1.1. Background

The literature review reported in Chapter 2 found a number of gaps in the knowledge base relating to the determinants of children's oral health. In particular, there has been a lack of studies looking at factors which influence parents' decisions about when and how often to brush their child's teeth at home.

Among the small number of studies which have looked at parental factors in relation to children's toothbrushing, there has been a tendency to apply existing theories of behaviour change, such as the Theory of Planned Behaviour or the Health Belief Model. Relying on these broad behavioural theories to explain parents' decisions about children's toothbrushing has a number of limitations. Firstly, as considered in Chapter 2 (Section 2.8.1), they have been criticised for failing to account for wider social and environmental factors which can influence and constrain people's behavioural choices. Secondly, as these theories are necessarily broad in focus, they may not be able to account for some decision processes which are unique to oral health.

The decision to use a qualitative research approach for the current study was based on two factors. Rather than measuring toothbrushing behaviour, the intention of the study was to understand how parents made decisions about brushing their child's teeth at home, and the context in which those decisions were made. For this reason, a qualitative, interpretivist approach was judged to be most appropriate. Watt has previously argued that qualitative techniques are an essential tool for understanding the wider determinants of people's oral health behaviour because "people's behaviours are enmeshed within the social, economic and environmental conditions under which they are living" (Watt, 2005).

Secondly, because there was relatively little knowledge about the research area, it was felt that an inductive, qualitative approach was more suitable. Inductive research is aimed at generating ideas and hypotheses, rather than testing existing theories. To this

extent, the study was designed to be exploratory in nature. There were no pre-conceived ideas or theories applied when designing research materials or when analysing the data. Instead, the purpose was to allow participants to discuss their own experiences with brushing their children's teeth in order to try and generate new ideas, concepts and themes which might be further explored in subsequent quantitative studies. This is consistent with Newton and Bower's suggestion that "qualitative research in oral epidemiology would be most useful in providing a theoretical base for quantitative research, including the development of valid measures" (Newton and Bower, 2005).

4.1.2. Research aims and objectives

The aim of this study was:

- ***To identify social, environmental and cognitive factors which influence low-SES parents' decisions about when and how often they brush their child's teeth at home***

The objectives were:

- ***To conduct in-depth interviews with parents, using largely open-ended questions, in order to explore how they make decisions about when and how often to brush their child's teeth***
- ***To analyse the interviews thematically, in order to identify novel themes, ideas and concepts which could be further explored in subsequent quantitative studies***

4.2. Methods

4.2.1. Participants and recruitment

Study population

Eligible participants were parents of young children (3-6 years old) who were participating in the Designed to Smile project. The Designed to Smile scheme is deliberately targeted at schools located in areas of high deprivation, and because nursery and infant schools are populated by children from surrounding 'catchment areas', parents whose children take part in the scheme are typically resident in high-deprivation areas. Participation in Designed to Smile therefore acted as a proxy for socio-economic deprivation.

Recruitment

Parents were recruited from two Designed to Smile schools in South-East Wales and two schools in North Wales (the regions where the toothbrushing scheme was taking place at the time). The schools were randomly selected from the full list of schools taking part in the Designed to Smile scheme.

In order to access a varied group of participants (and therefore viewpoints), recruitment of parents was facilitated by staff from the Community Dental Service (CDS). The CDS staff oversee the day-to-day running of the scheme and have good relationships with schools and parents through their experience of working in the community. The use of a 'gatekeeper' to aid recruitment is a common practice in qualitative research, and is particularly useful when trying to recruit groups who may otherwise be reluctant to take part in research. The idea is to harness the ability of a person or group of persons who have "a prominent role in the local community, are typically knowledgeable about the characteristics of community members and are sufficiently influential to encourage community members to participate in a study" (Hennink et al., 2010).

Eligible parents were approached by CDS health promotion staff in the school setting (either through parent meetings, or when collecting children from school), and asked if they would be willing to take part in a telephone interview about their experience of brushing their child's teeth at home. They were given an information sheet (Appendix 1) explaining each aspect of the research. If they were interested in taking part, they were asked to complete a consent form (Appendix 1) and provide a contact number, which CDS staff then returned to the researcher.

Recruitment of parents took part in three 'waves'. Initially, CDS staff in South-East Wales and North Wales were both asked to recruit three parents from the randomly selected schools who met the criteria of having children aged between 3-6 years old. After this first wave of recruitment, the choice of participants was guided to some extent by *theoretical* or *emergent sampling*, whereby parents with certain characteristics were intentionally sampled in order to test and develop themes which had been developed from analysing the data from the first wave of interviews (Figure 4.1).

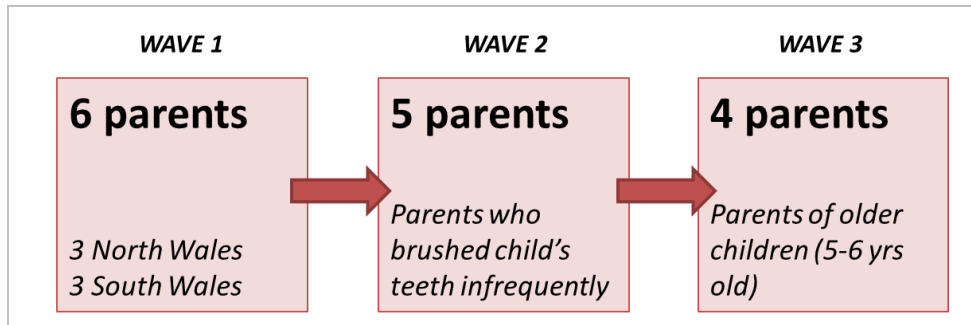


Figure 4.1: Study 1: Illustration of the theoretical sampling technique used for recruiting study participants

The CDS staff were able to facilitate the theoretical sampling process, by using their familiarity with parents to select participants with certain characteristics (e.g., parents who brushed their child's teeth infrequently).

Recruitment continued until 'theoretical saturation': the point at which enough themes had been identified and were felt to be sufficiently clear and well-defined that successive interviews were not generating any further ideas.

4.2.2. Data collection

Data were collected via a series of one-to-one, semi-structured interviews with parents carried out over the telephone.

Interview schedule

The interviews with parents were semi-structured. The aim of the study was to encourage parents to talk about their own experiences and to generate new ideas, so a fully structured interview was considered unsuitable. It was felt, however, that a small number of very open questions would provide some direction for the interviews and so be more likely to generate relevant findings than an entirely unstructured conversation.

A broad interview schedule or guide was used for each of the interviews (Appendix 2). The schedule was piloted with two parents before the main study began. Some minor changes to the guide were made based on these two interviews.

The final schedule included:

- an introduction
- a series of opening questions aimed at collecting basic demographic details
- a series of brief questions about the Designed to Smile toothbrushing scheme
- a series of open-ended questions about toothbrushing at home
- two closing questions inviting participants to discuss anything else they felt relevant and to ask any questions of the interviewer

The introduction to each interview had a number of aims. It allowed the researcher to clearly explain the purpose of the project to the interviewee and to re-iterate a number of the issues relating to anonymity. Secondly, the introduction 'positioned' the interviewer as a researcher interested in toothbrushing rather than a dentist or dental professional, in the hope that this would decrease any burden on the participant to exaggerate their oral health behaviour. A scripted introduction also allowed a degree of standardisation between interviews, ensuring that all parents taking part received the same background information and opening questions.

The main questions about toothbrushing were deliberately open-ended, with the participant encouraged to talk about aspects of toothbrushing that were relevant to them. Initially, there were three questions about brushing a child's teeth at home:

- Tell me about your experience of brushing [child's name]'s teeth at home...
- What things do you think make brushing [child's name]'s teeth easier, for you?
- What things do you think make brushing [child's name]'s teeth more difficult, for you?

These three questions served only as a starting point, with the remainder of the interview directed by participants' reported experiences. A series of simple, probing follow-up questions or responses ('tell me more about that', 'why do you think that is?') were employed to motivate the interviewee to share as much information as possible. The small number of open questions was consistent with the inductive nature of the research, where the purpose was to understand parents' experiences in their own words rather than to test existing theories or ideas.

After each interview, the researcher listened back to the full recording and made a set of written notes. After each 'wave' of interviews, the three main questions from the original interview schedule were added to and refined in order to elicit more information on emerging concepts and themes. The evolution of the interview schedule is shown in Figure 4.2, where 'X' refers to the child's name.

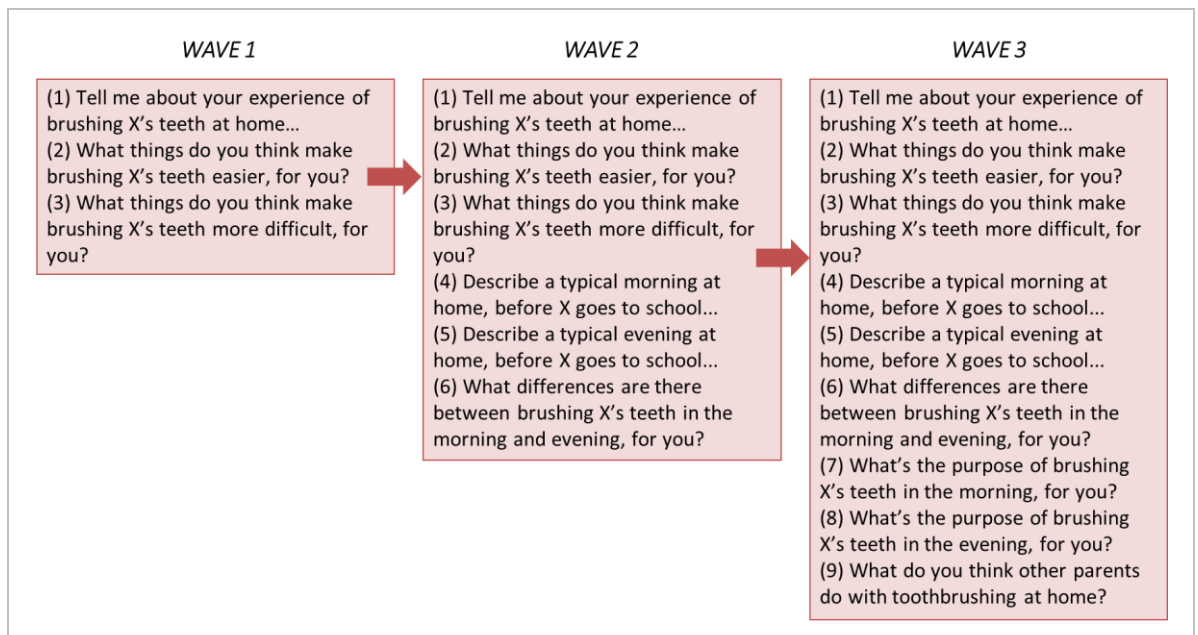


Figure 4.2: Study 1: Evolution of the interview schedule across recruitment waves

4.2.3. Procedure

Consenting participants were contacted using the provided phone number and a suitable date and time was arranged for the interview to take place over the phone.

Interviewees were each asked for permission to digitally record the interview, and all agreed. Digital recording of the interviews allowed for accurate transcription of the conversations and prevented the need for excessive note taking which might distract from responding to the participant's thoughts (Bryman, 2012). The phone conversation took place on an Apple iPhone using the 'speakerphone' function, and the interview was recorded using a separate digital recorder.

Participants were asked to put aside approximately one hour for the conversation, and asked to find a quiet room. They were given the opportunity to ask questions before the recording began and after the interview had ended and recording had stopped.

4.2.4. Data analysis

Because the objective of the study was to generate ideas rather than to test existing theories, an inductive approach to data analysis was thought to be most appropriate. With an inductive approach, concepts and themes are strongly linked with (or grounded

in) the data themselves. It is an approach to coding and identifying patterns in data 'without trying to fit into a pre-existing coding frame or the researcher's analytic preconceptions' (Braun and Clarke, 2006).

Two of the most commonly used inductive approaches to analysing interview transcripts are grounded theory (Charmaz, 2006, Glaser and Strauss, 1967) and thematic analysis (Braun and Clarke, 2006). Both approaches share a general pattern of analysis, where transcripts are first read through in detail to identify basic 'codes' or ideas, before being grouped according to similarity to create higher-level 'concepts' or 'themes'. Grounded theory is concerned with eventually building a formal, unifying theory from the data, whereas thematic analysis is concerned with the creation of broad themes.

As the study was part of a broader mixed-methods research framework, the aim was not to develop a formal theory, but to identify relevant themes which might be further explored in a subsequent, quantitative stage of the research. Interview data were therefore analysed by thematic analysis. Thematic analysis is an approach to analysing qualitative data which provides a method for "identifying, analyzing and reporting patterns (themes) within data" (Braun and Clarke, 2006).

Rather than wait until the end of the study to analyse the data, transcripts were analysed in batches so that the results from earlier interviews could inform the sampling of participants, and the interview schedule. Figure 4.3 summarises this iterative approach.

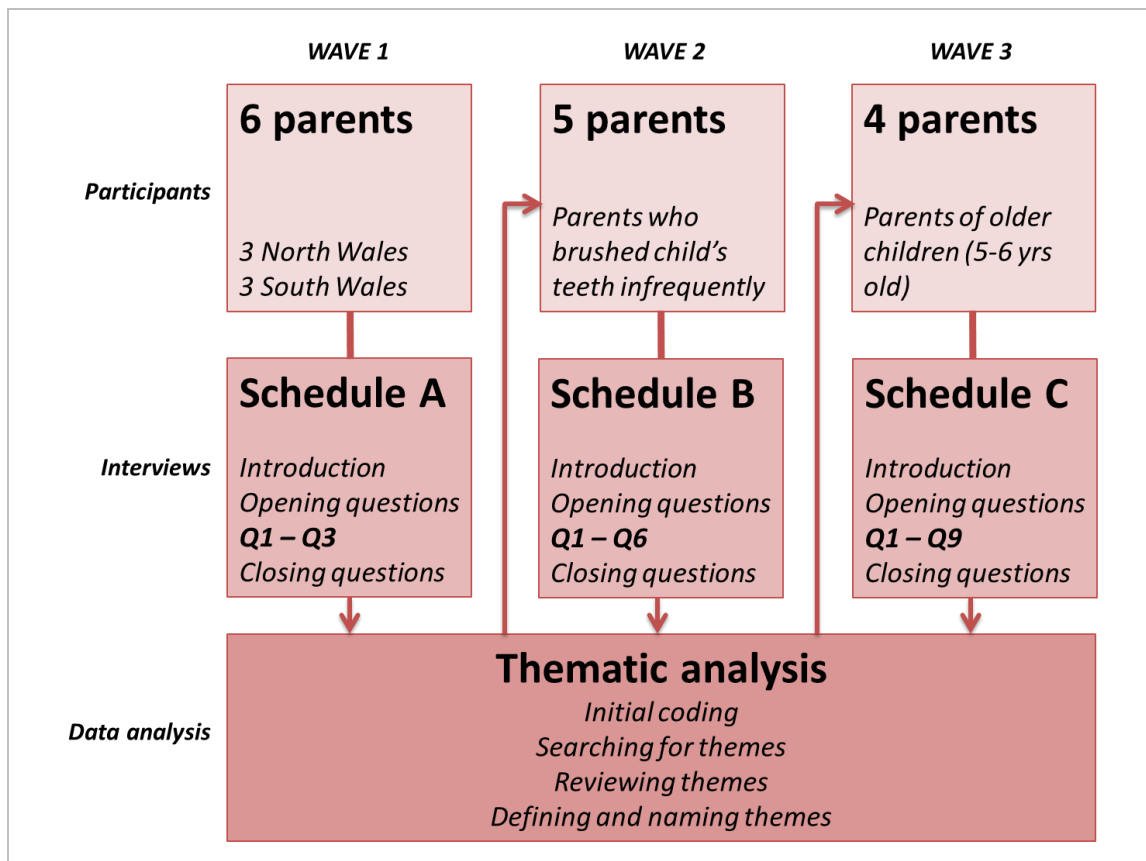


Figure 4.3: Study 1: Overview of the iterative research approach used for recruitment, data collection and analysis

Analysis of the transcripts was guided by the five-step process to thematic analysis suggested by Braun and Clarke.

Step 1: familiarizing self with data

At each stage of analysis, the interviews were transcribed verbatim by the researcher (before being anonymised), and were then read in full before any coding took place. This 'pre-coding' period allowed the researcher to 'get a sense of the whole' before beginning to code individual transcripts.

Step 2: generating initial codes

Initial coding involved returning to the transcripts, reading through them line-by-line and labeling words, phrases or sections of text that capture key ideas about a parent's thoughts about toothbrushing at home. These primary code labels often used the participant's exact phrasing. These are sometimes referred to as *in vivo* codes (Strauss and Corbin, 1990). They are typically a fairly literal description of what was being

expressed, to avoid trying to interpret interviewee's thoughts through the use existing concepts or theories.

Step 3: searching for themes

The next step was to reduce these primary codes into a smaller set of themes, by grouping thematically similar codes together. This grouping of primary codes into themes was facilitated by use of the 'constant comparative method' (Strauss and Corbin, 1990) where codes are constantly checked against each other and the data throughout the research process, in order to find areas of convergence. For instance, analysis of the first set of interviews generated primary codes such as "fresh breath", "clean teeth" and "nice appearance" which were felt to reflect a common concept of "short-term benefits of brushing", and was later integrated into a broader sub-theme of "short-term vs. long-term benefits of brushing".

After the first batch of interviews had been analysed and coded, the researcher met with a supervisor to read through the transcripts and discuss the themes that had been identified from these initial interviews. This provided an opportunity to identify areas of consensus and disagreement, and aided the analytic process of defining and re-defining themes.

Step 4: reviewing themes

The creation, refinement and addition of themes was a continual process throughout the research cycle, and was aided by a process of memo-writing. Memos took the form of small written notes, diagrams or tables which attempted to conceptualise ideas and thoughts that arose during the coding process (Charmaz, 2006).

The researcher consistently checked that primary codes assigned to each theme were conceptually similar to each other and different from those coded into other themes. This is a process that Patton describes as ensuring 'internal homogeneity and external heterogeneity' of the themes (Patton, 1990).

Step 5: defining and naming themes

Three themes were finally generated, which were felt to represent the most salient issues addressed by the interviewees. These are described in detail in the results section.

4.2.5. Research ethics

The study was conducted as part of a larger service evaluation of the Designed to Smile toothbrushing scheme, on behalf of the Welsh Government.

All parents gave informed consent before taking part in interviews, and were aware of their right to withdraw from the study at any point. Participants all gave permission for the interviews to be digitally recorded. Interview transcripts were all anonymised.

4.3. Results

4.3.1. Demographics

Table 4.1 gives basic demographic details for each of the 15 study participants. Eight parents from South Wales were interviewed, and seven from North Wales.

ID	Region	WIMD quintile	Parent gender	Parent age	Child gender	Child age	Reported brushing frequency
01	North Wales	5	F	32	F	3	Twice a day
02	South Wales	5	F	29	F	4	Once a day
03	South Wales	3	F	25	M	4	Twice a day
04	North Wales	4	F	41	M	4	Twice a day
05	North Wales	3	M	35	F	5	Once/twice a day
06	South Wales	4	F	25	M	3	Twice a day
07	South Wales	4	F	28	F	3	Once a day
08	North Wales	5	F	33	F	5	Rarely
09	South Wales	5	F	35	M	4	Once a day
10	South Wales	4	F	30	F	4	Once a day
11	North Wales	2	F	36	M	4	Twice a day
12	North Wales	5	F	-	M	5	Once/twice a day
13	North Wales	3	F	24	F	6	Twice a day
14	South Wales	4	M	28	F	6	Once a day
15	South Wales	5	F	26	M	5	Twice a day

Table 4.1: Study 1: Demographic details of the study participants

The vast majority of parents interviewed were female, and were aged between 23 and 41 years. The children under discussion were aged 3-6 years old. In keeping with the targeted nature of Designed to Smile, most parents were resident in areas of relative

deprivation (indicated by higher deprivation quintiles). In total, nine parents reported that they usually brushed their child's teeth twice a day, five parents reported that they typically brushed their child's teeth once a day, and one parent reported rarely brushing their child's teeth.

4.3.2. Overview

Figure 4.4 illustrates the major themes and sub-themes which were developed from the interviews. These were:

- Toothbrushing motivation
- Toothbrushing context
- Toothbrushing norms

These themes and their associated sub-themes are described in more detail in the following sections. The quotes serve to illustrate some of the more common themes as well as highlighting some of the unusual or dissenting cases.

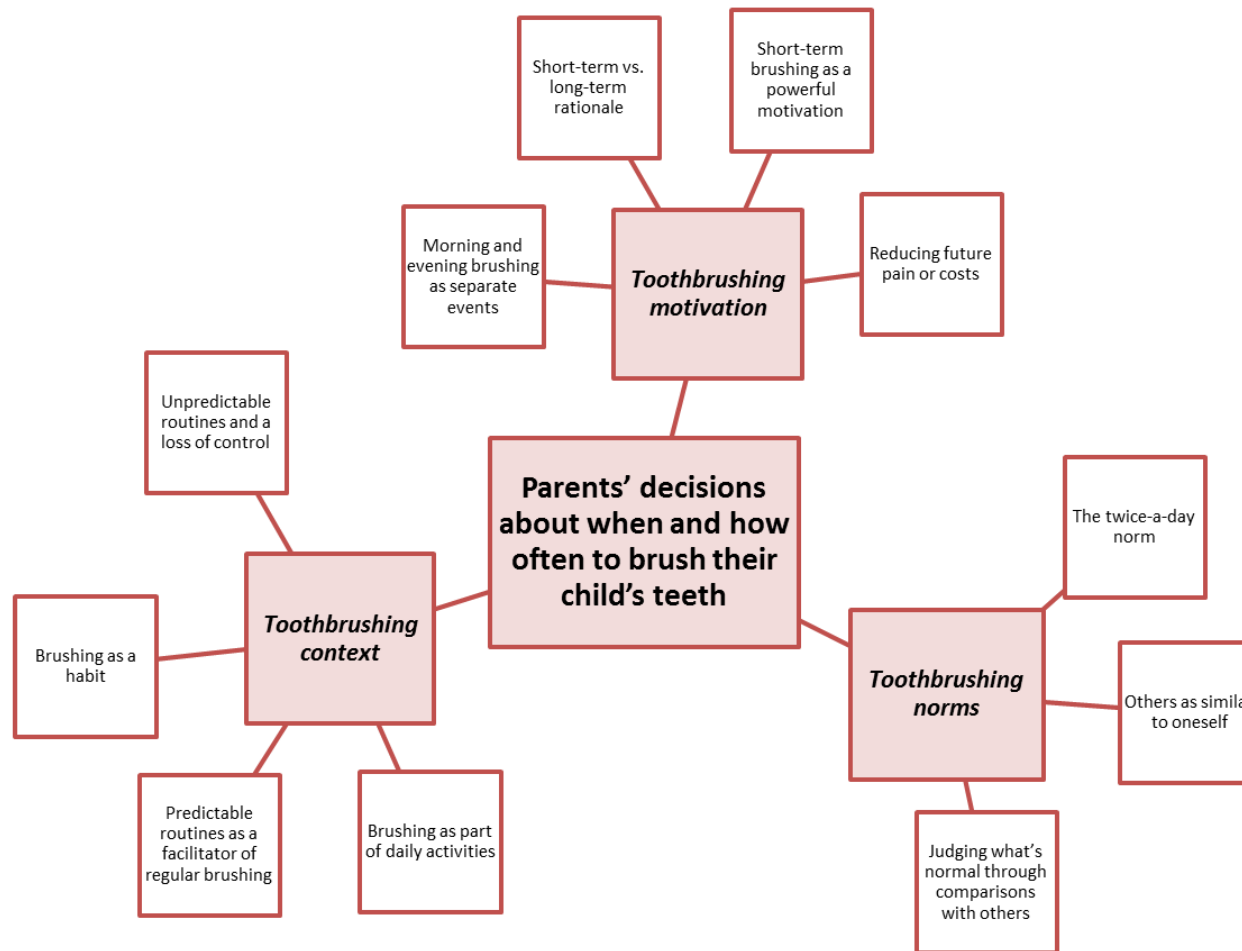


Figure 4.4: Study 1: Overview of the main themes and sub-themes developed from parent interviews

4.3.3. Theme 1: Toothbrushing motivation

In the early stages of data collection, it became apparent that parents had a number of different reasons and motivations for brushing their children's teeth. Parents offered these explanations for brushing without any prompting initially. 'Motivation for toothbrushing' was thus identified as a theme early on, and later interviews were structured so that parents were asked more directly about the reason that they brushed their children's teeth.

As the interviews progressed, a number of sub-themes relating to motivation were developed. A distinction between short and long-term rationales for brushing was identified, as was the idea that morning and evening brushing were often carried out for different reasons. Two other ideas emerged: the notion that morning brushing was seen as particularly important, and the fact that some parents described brushing as a form of long-term investment.

Short-term vs long-term reasons for brushing children's teeth

When parents talked about why they brushed their child's teeth, there was a clear distinction between reasons which focused on *short-term* outcomes and those which focused on *long-term* outcomes.

Short-term reasons were very common, and tended to be associated with achieving immediate benefits. Parents typically described brushing children's teeth as being important for a child's hygiene and appearance.

[P06] You know, you want to make sure he has clean teeth, nice shiny teeth.

[P11] To get the food out of their teeth, you know, if there's food in your teeth, there's bacteria. It's fresh breath, nice, shiny, smooth silky teeth.

Sometimes, however, parents spoke about brushing for long-term reasons. These were typically associated with trying to reduce the risk of negative outcomes. Parents spoke about brushing their child's teeth to avoid their child experiencing pain when they were older, or having decayed teeth in the future.

[P05] I suppose it's getting rid of any bacteria and stuff, so that it doesn't cause her teeth to be rotten in the long run.

Morning and evening brushing as separate events

When parents explained what motivated them to brush their children's teeth, many drew a clear distinction between brushing their child's teeth in the morning and brushing their child's teeth in evening. Rather than considering toothbrushing as a singular event, it was clear that morning and evening brushing were seen as being different.

Consistently, parents reported different reasons for brushing their children's teeth in the morning and in the evening. Overwhelmingly, the motivation for brushing in the morning was more short-term: hygienic, in the sense that it made teeth *feel* clean and ensured fresh breath, and cosmetic in that it made teeth *look* clean.

*[P13] I wouldn't skip brushing her teeth in the morning, even if she's brushing in the afternoon. **And why's that?** That's still the whole morning where her teeth wouldn't be clean - you can easily tell when they don't brush their teeth you know, I say that to her - doesn't it feel much better when your teeth are nice and clean?*

[P09] It's just so he's clean, you know, in the morning, after he's eating. His teeth are clean and he's presentable.

[P05] And no, I can't let him leave the house without having a wash, brushing his hair and cleaning his teeth!

The motivation for brushing children's teeth in the evening was more varied. Whereas parents were quick to give reasons for brushing their child's teeth in the morning, many parents (even those whose children regularly brushed twice a day) struggled to explain their reason for toothbrushing in the evening.

Some parents conceptualised evening brushing as the removal of food that had 'built up' during the day. To this end, the importance of evening brushing was contingent on the sort of food that their child had eaten throughout the day. If they had consumed a lot of sugary food or drink, toothbrushing was seen as more important; if they had eaten relatively 'healthy' food, toothbrushing was less important.

[P03] Well it's all the food he's eaten all day, isn't it. You want to remove that, so he doesn't get bacteria and plaque and everything.

[P05] Well if she's eaten well, and she's a bit tired, then we might just do it in the morning instead – but then if she's had a lot of pop, or some sweets, then I just make sure we do it, even if I have to do it for her.

In general, the benefits of evening brushing were more likely to be the long-term reasons discussed above, where the benefits occurred later on. There was a sense that evening brushing helped keep teeth 'healthy' and reduced the risk of future problems when children were 'older'.

[P11] It's about putting on that toothpaste, and then it's all got night to work on his teeth, hasn't it? He's not eating then, so it's better, it's got time to work. Keep them healthy as he grows up.

Not all parents made such a distinction between reasons for brushing in the morning and evening, however. This parent, for instance, talked about how brushing as often as possible was the main goal, regardless of time of day.

*[P06] I think it's just that you want to do it as often as you can, isn't it
If that's in the morning or in the evening – I don't think it matters so
much, does it? For me anyway. It's just keeping their teeth healthy.
Just as often as you can get them do it.*

Short-term benefits as a powerful motivator

Rather than being seen as superficial, cosmetic reasons for brushing seemed to provide an extremely powerful motivation for brushing. There was a sense that a child's appearance (to the extent that it was under their parent's control, in the same sense as their clothes or their hair cut) reflected on parenting skills; so that sending their child to school with 'dirty' teeth would be seen as neglectful, just as it would to send them to school with dirty clothes. In this sense, the impact of not brushing a child's teeth would be visible and so the negative consequences would be fairly immediate.

*[P15] I think it must be obvious to the teachers which children have
brushed their teeth, and which ones haven't. I guess as a parent you
don't want the teacher thinking that you don't look after your child,
yeah, so that's a big thing*

*[P14] It's just general hygiene, isn't it? And their appearance. You
wouldn't let them out of the door with muddy trousers, or food all over
them, and their hair all scruffy, and everything. So it's just part of that,
really.*

*[P03] I couldn't let him go into school with dirty teeth, so you just
make sure he brushes in the morning. **And what if it's a particularly
busy or hectic morning?** I'd rather he was late for school than we
missed brushing!*

For some parents, who appeared to consider the reason for brushing to be primarily for the purposes of short-term hygiene and appearance, evening brushing seemed to be less important. In these cases, brushing a child's teeth in the morning served the main purpose of oral hygiene.

[P02] And how about the evening? I think in the morning, you just want to make sure they've got fresh breath and everything, but in the evening, well for me it's not as big a deal if they're brushing the next morning anyway

[P12] I know they're brushing in the morning, so I'm not fussed if they may miss it once or twice in the evening. If they go to bed late, it'll only end up being harder to brush in the morning anyway.

Brushing children's teeth to reduce future pain or costs

A few parents referred to the cost of adult dental care, and so to some extent saw evening toothbrushing as a form of investment: a small burden now, but a reduction in costs (as well as time and discomfort) in the future.

[P04] Yeah, you think about how much it costs just to have a check-up sometimes, and then if you start getting loads of fillings, it's going to be even more. So I'd rather have a big fight with him now, get him in the habit of brushing his teeth, than spend hundreds of pounds at the dentist when he's a teenager!

[P13] Yeah, a few minutes a day now, brushing their teeth, and that's not much is it? When you think how much people have to pay for having all sorts of stuff done at the dentist, I think it'd be stupid not to start brushing now.

Given the emphasis on cosmetic reasons for brushing in the morning, and the association with 'social benefits' (i.e., having a nice external appearance), it is interesting to note that the perceived long-term benefits of evening brushing were focused on reducing the risk of pain or discomfort (internal), rather than maintaining a nice appearance.

4.3.4. Theme 2: Toothbrushing context

During early interviews, when parents were asked to talk in detail about their experiences of toothbrushing at home with their child, they frequently made reference to the context in which toothbrushing took place among various other daily routines occurring the home. It was clear that brushing children's teeth was just one small part of a parent's day, and needed to be seen in this larger context rather than an isolated event. In later interviews, as the theme of 'toothbrushing context' was developed, parents were asked to describe a typical morning and evening at home and explain how (if at all) toothbrushing fitted in with that.

Various sub-themes were developed from the transcripts, including the idea that toothbrushing was often temporally linked to other frequent activities. Because it occurred in the home, the stability of day-to-day routines was identified as having a positive or negative effect on parents' ability to brush children's teeth regularly. Finally, the idea of a toothbrushing 'habit' was explored.

Toothbrushing as part of daily activities

Toothbrushing was, invariably, temporally linked to other daily activities. For those parents whose children brushed in the morning, it fitted in either before or after an event like waking up, eating breakfast, having a wash, bath or shower, getting dressed in school clothes and leaving the house for school. For those parents whose children brushed in the evening, it fitted in either before or after an event like getting home from school, having dinner, doing homework, having a wash, bath or shower, getting changed into pyjamas and going to bed.

[P01] We're quite predictable – things happen in a certain order! So we always get up, have breakfast, then brush their teeth, then it's get changed and out we go!

[P10] Yeah, they have their bath, they come down and they have their supper, which is normally a glass of milk and a cookie and they go back up and brush their teeth before bed. Toilet and teeth! Toilet and teeth and then bed.

[P07] Yeah, it's upstairs, brush your teeth and then bed. Toothbrushing is the last thing that they do before they get into bed.

Because these initial interviews had showed that toothbrushing (where it took place) occurred as one part of a larger morning or evening routine, subsequent interviewees were asked to describe a 'typical' morning or evening, and then prompted to explain if and when toothbrushing fitted into that overall sequence.

For many of the parents, morning routines – although often described as hectic and stressful – appeared to be fairly consistent, following a set pattern. The order of events differed between households, and some activities, such as eating breakfast or showering, didn't occur in every household, but within each house the sequence was usually the same each day. To this extent, toothbrushing usually had a set time and place in the morning.

In many cases, evening routines appeared to be far less stable. Some parents worked unpredictable hours through shift-work. A couple of participants described how, as single parents, they would often have to leave children with friends or family until they could collect them after finishing work. In these cases, evening routines – from the child's perspective at least – differed quite significantly throughout the week. For relatively older children (5-6 years old), factors such as occasional homework or after-school clubs were mentioned as extra distractions.

Unpredictable routines as a barrier for regular brushing

Where routines were less predictable, parents often reported a feeling of having less *control* over whether children brushed their teeth or not. This was particularly the case in the evening.

[P04] We do try and get her to do it in the evening too, but it's hard isn't it? I don't know if I'm always going to be back in time [from work] to get everything done, so if I'm honest, it does mean we don't always brush her teeth before bed... so yeah, I would try, but it just depends on work and things like that.

Inconsistent evening routines often meant that activities such as getting home, eating dinner and washing occurred at different times. When parents had less time with their children, it became more apparent that toothbrushing was sometimes less of a priority than other activities. Ensuring children had something to eat and went to bed on time were typically seen as priorities over activities such as brushing teeth.

[P14] They just... at the end of the day, it's just hectic. Especially with after school things now. Because we've only just got in now [7:15pm] and I like the kids in bed for seven. That's their routine. But because we've started doing these extra outside of the school things now, we're rushing about and doing things. I'm reading books and we're doing homework now, so it's just hectic, so you just sometimes miss it. They need to be in bed, don't they?

[P12] Because sometimes, because she's older now, sometimes she's too tired, and it is... she's just flaking out, and she's got to go to bed, and we'll miss it.

[P08] I don't think it's as important as things like exercise and healthy eating. Not that I'd say there's no point in brushing your teeth, but I think.... maybe, it's... I mean I think it's important, but probably not as important as those other things, no. And definitely sleep, because you know that affects their entire day.

As a result of these differences in evening routines, toothbrushing was sometimes missed out in the evening. In other cases, even when parents reported that it did take place regularly, it often varied in terms of the time it took place, or at least the way it fitted in sequentially with other events.

[P10] And that's because of school activities, so sometimes it's you know, get back and straight into bed. So as I say, maybe twice or three times a week, we don't brush of an evening. And that's one of the reasons. I'd rather my children in bed for seven, so that becomes their routine. And I know, of course, that brushing only takes two minutes, but it's... my days long as well, so the kids can go to bed and they can brush them in the morning. That's my thinking on it.

[P04] If we're really late, we'll eat out. Or general days, when we're back about five, you know, we'll have our dinner, then half past six, it'll be bath and we'll do their teeth whilst we're in the bathroom and they'll go to bed then. That's most days, but a hectic day we'll maybe just have tea and go straight to bed.

Predictable routines as facilitators of regular brushing

In contrast, when parents had a more stable daily routine, toothbrushing often took place at a consistent time and place each day (whether in the morning or evening). In

such cases, it was apparent that parents saw it as requiring less conscious effort on their part, because children were used to doing it.

[P11] I think it's routine. If you've got them into a routine of brushing their teeth, then I guess they don't know anything different. Yeah, totally we have set routines, for waking up, for breakfast, we try and stick to the same thing or it'd be a challenge getting to school on time!

When toothbrushing didn't occur at the same time, or in the same context – most often in the evening for the reasons described above – parents described there being a greater effort to initiate it.

[P15] It's not something he does on his own – I have to remind him every day! ... It's a constant battle.

Developing a brushing 'habit'

Among parents who reported brushing their child's teeth twice a day, brushing teeth was commonly referred to as a 'habit'. The inference was typically that it didn't require much interaction between parent and child, it 'just happened' automatically.

[P01] They're just in a habit now. We don't have to talk about it really, they're just used to doing it... it's something they do, just like getting dressed or anything else.

[P11] And how does that change if the evening is busier than usual? No... it's kind of automatic... I just brush his teeth before bed every day without thinking about it!

Some parents explicitly mentioned that establishing a 'toothbrushing habit' was a goal they were aiming for while their child was still young. They were conscious that, as their

child grew older, they would have less direct control over their actions and so hoped that a habit would be 'ingrained' by the time their child had more autonomy. A number of parents also suggested that getting children into a routine of brushing would help them develop this habit.

[P06] Well when he's six or seven, he's not going to be happy letting me brush his teeth, is he? So it's about getting him used to it, into a routine. At some point, he's going to be old enough that he'll have to decide for himself, and so it'll just be a habit for him by then.

4.3.5. Theme 3: Toothbrushing 'norms'

Throughout the interviews, it became apparent that parents' decisions about how often to brush their child's teeth were not made in a social vacuum. The theme of 'toothbrushing norms' was developed to reflect the different sources of information that parents made reference to when discussing how often they brushed their child's teeth.

Parents often referred to the idea of what they 'should' do and were typically aware of the 'twice a day' message. Perhaps more surprisingly, though, they commonly referred to what they thought other parents did and this often seemed to be a more important reference. Other sub-themes were later developed, including the tendency for parents to assume that other parents behaved similarly to themselves, and the idea that parents might decide on how happy they were with their own child's brushing routine in relation to what they thought others might be doing.

Brushing 'twice a day'

Over the course of the fifteen interviews, almost every parent made an unprompted reference to the twice-a-day toothbrushing message when discussing home brushing, regardless of how often they actually brushed their child's teeth. This suggests that the traditional message, that children and adults should endeavour to brush their teeth every morning and evening, was well understood among this group.

When prompted, parents were not always able to remember where they had learned about the twice-a-day message. Some mentioned their dentist, while others mentioned that they had just 'always done' it. Most parents, even those who did not brush their children's teeth regularly, felt that it was fairly common knowledge.

[P11] It's just what I've always done! Yeah. Not that when I was young... no, I didn't brush twice a day. I was brought up in Glasgow as a child, and we used to live on pop and sweets, and had bad, well teeth were rarely thought of – we used to stuff our face with sweets and ginger pop and things, so I have a few amalgam fillings and my

teeth aren't as good as they should be. So it's only now that I'm really up on these things.

[P13] ...and I think it's because of what people tell you, because the dentist tells you twice a day. I think it's circumstances, if you could, it'd be brilliant to brush after every meal but obviously life isn't like that.

*[P03] **You say you brush at least twice a day at home – why twice a day? Because that's what you should do! And why do you think that? That's just something that I was always brought up to do.***

Estimating what others do

However, the extent that such a message was considered relevant to parents' decision making appeared to depend on whether or not they believed that it reflected the reality about what 'other people' actually did.

For parents who believed that very few other parents brushed their child's teeth twice a day, the message about what you *should* do was not necessarily considered credible.

[P08] And everyone says it's twice a day you should do. But you're supposed to do lots of things! I think most parents are realistic... they don't all brush their children's teeth every day. You've got so much going on. It's just not going to happen is it? A lot of them won't ever do it, I bet!

Even those parents who reported that their children brushed frequently tended to qualify this by suggesting that most other people probably did the same.

[P11] I imagine most parents brush their children's teeth twice a day, yeah? That's the message, isn't it? I don't think it's that big a thing, really, so yeah, I think most parents would be the same as us.

In later interviews, parents were directly asked about how often they felt 'other' parents brushed their children's teeth. These 'other' parents were not defined in the question, but parents appeared to automatically draw comparisons with parents of other children in their child's school, or with their own friends and family who had children of a similar age.

[P04] It's not something you'd ever really talk about, to be honest, with other Mum's in the playground or my sister-in-law or anything like that. But I think... I don't know, I think they'd be very similar to me really, I'd hope so.

Others as similar to oneself

Overall, there was a wide range of views on how often other parents brushed their children's teeth. Often it followed that parents who brushed their children's teeth frequently thought that most parents did the same, and those who brushed their children's teeth less often were sceptical of the idea that other children brushed regularly.

[P12] I know it's supposed to be twice a day but let's be honest... there's no way everyone's got time to brush their children's teeth every morning and every evening without fail. I think they'd be lying, absolutely!

In contrast, some parents who reported brushing their children's teeth twice a day appeared to have difficulty believing that other parents might not do the same.

[P06] I mean, I guess there's always some people, but you know... but it's just such a little... it's not like a massive thing. I'd be pretty shocked if other parents didn't brush their children's teeth twice a day, yeah. I'd be worried!

When probed about their perceptions, it was apparent that many parents did not actually know what other parents did, but seemed instead to infer it based on what they did themselves.

[P04] It's not something you'd ever really talk about, to be honest, with other Mum's in the playground or my sister-in-law or anything like that. But I think... I don't know, I think they'd be very similar to me really, I'd hope so.

Judging what's normal through comparisons with others

When parents were asked how satisfied they were with how often their child brushed their teeth, they tended to focus more on making comparisons with 'other' parents and children than they did on tangible outcomes such as tooth decay or pain.

[P12] So I'm happy, yeah, we're probably average, I'd have thought.

[P10] You'd go mad worrying about things – it's just make sure we do it as much as we can isn't it. He's four years old, there's bound to be some days when it won't go to plan! And I'm sure we do it more than most people, so I don't worry about it all that much to be honest.

Some parents felt content with brushing their child's teeth once a day because they felt that was about average, while others expressed guilt or a desire to brush more often because they felt other parents may do more than themselves. One parent of a child

who brushed twice a day even expressed anxiety about their routine, because she thought that some other parents might brush their child's teeth three times a day.

[P03] Well we do it twice a day because that's what I've always been told, I guess. I don't know if some people brush their children's teeth after lunch as well, on the weekend, I don't know... I guess I haven't thought about that... maybe that's something we could do, I suppose.

Not all parents appeared to be influenced by what they thought other parents did, however. A small number of parents were clear that their decision about how often to brush their child's teeth was based on what was 'right' and were unconcerned by what others did.

*[P13] Because you can see it in his class – some of those kids, their teeth are almost black. And that makes you think of what the parents are doing, you know.. **Do you think if you knew that a lot of other parents didn't brush their children's teeth twice a day – do you think that would affect what you did?** No, of course not. Twice a day is what I've always been told, and that's what you do isn't it. I's not hard to do, so I think you do have to look at the parents. No... it wouldn't change what we do.*

*[P15] **And do you think if some of your friends, or other family members, if they said that they don't really brush as much, maybe they just brushed once a day, or not at all, do you think that would change what you thought?** I would tell them! No, it wouldn't change my mind on how I do things. But I would sort of say to them, oh I think that you should brush them more! As long as it was a best friend, or family!*

4.4. Discussion

4.4.1. Key findings

The aim of this study was to better understand parents' decisions about how often and when to brush their young children's teeth at home. Through a series of exploratory interviews, three major themes were developed describing different factors which appear to influence parents' decisions in this area. The results suggest that parents' rationale or motivation for brushing children's teeth, the context in which toothbrushing takes place in home and parents' perceptions of what their peers do are all relevant to understanding how often parents brush their children's teeth.

The idea that many parents were equally or more concerned about cosmetic factors than long-term factors when considering toothbrushing is broadly consistent with other findings reported in the literature with older children and adolescents. Gill and colleagues, for instance, found that 10-11 year old children often rationalised brushing as cleaning or refreshing their mouth (Gill et al., 2011), while others have reported similar findings with adolescents (Macgregor and Balding, 1991, Stokes et al., 2006). This is the first study, however, to suggest that parents may also think about short-term factors when deciding when and how often to brush young children's teeth. Many parents also gave different justifications for brushing a child's teeth in the morning and evening, suggesting that it may be necessary to consider morning and evening brushing as being motivated by different factors.

Within oral health research, a small number of qualitative research studies have suggested that oral hygiene behaviour in adolescence may be influenced by peer groups and perceived group norms (Hodge et al., 1983, Stokes et al., 2006). However, this is the first study to suggest that people's perceptions of how often others brush may be associated with their own oral health decisions and behaviour. The fact that many parents justified their own decisions about how often to brush their child's teeth

by referring to what they thought other parents did suggests that parents' decisions may be influenced by perceptions of what other people do.

Given the emphasis on repetition in relation to toothbrushing oral hygiene, it is perhaps surprising that more research has not considered the context in which toothbrushing takes place among other daily routines and events. Aunger acknowledged the idea of toothbrushing as a 'routine' behaviour (Aunger, 2007), and earlier research by Croucher discussed the importance of considering toothbrushing as being influenced by people's daily schedules (Croucher, 1994). Routines have also been mentioned by parents in other qualitative work. Cortes and colleagues, for instance, interviewed Latino, Spanish-speaking parents of young children and found that they discussed the importance of 'establishing good routines' for their child in relation to both toothbrushing and diet (Cortes et al., 2012). However, no studies to date have explored the extent to which people's home environment and routines might facilitate or inhibit regular brushing behaviour. One of the closest parallels in the wider health literature is medication adherence, where behaviour occurs primarily in the home and positive outcomes are highly dependent on frequent and regular actions. Indeed, previous qualitative work in that field has suggested that people's home lives play an important role in determining how likely they are to take medication at regular intervals (Ryan and Wagner, 2003).

Finally, parents who brushed their child's teeth twice a day often used the word 'habit' to describe their actions. This finding suggests that habit might be a concept worth further exploring in relation to toothbrushing.

4.4.2. Methodological considerations

Telephone interviews

Telephone interviews were chosen over face-to-face interviews primarily for pragmatism, given the requirement to interview parents from two different geographical areas. Research also suggests that busy or reluctant participants are more likely to

agree to telephone interviews than face-to-face interviews conducted in their home (King and Horrocks, 2010).

Potential disadvantages of telephone interviews compared to face-to-face interviews include the lack of control over the interviewee's environment during the interview and the absence of body language cues to guide the interviewer (King and Horrocks, 2010). The extent to which face-to-face interviews are likely to lead to richer data has been questioned by some researchers, however. Sturges and Hanrahan, for instance, conducted research using a mixture of face-to-face and telephone interviews for pragmatic reasons, and concluded that there were no differences in the "quantity, nature and depth of responses" between interview data collected using the two different approaches (Sturges and Hanrahan, 2004).

4.4.3. Data quality and limitations

Qualitative research has traditionally been criticised for lacking the methodological rigor of quantitative research. Denzin and Lincoln, for instance, refer to the perception that qualitative work "is often termed unscientific, or only exploratory, or entirely personal and full of bias" (Denzin and Lincoln, 2005). A recent review of qualitative research in oral health concluded that the quality of the research was 'mediocre' (Masood et al., 2011).

In quantitative research, the two most commonly applied principles in the evaluation of research quality are reliability and validity (Burns, 2000). Reliability refers to the extent to which the results of a study are repeatable, while validity is considered "the extent to which an account accurately represents the social phenomena to which it refers" (Hammersley, 1990). There has been considerable debate about whether or not these two criteria can be fairly applied to qualitative work (Bryman, 2012).

Some qualitative researchers argue that the use of reliability and validity as yardsticks infers an objectivist theoretical standpoint more closely aligned with quantitative work – that is, the belief that there is an objective truth which can be accurately measured

(Denzin and Lincoln, 2005). Others, however, argue that reliability and validity are equally important concepts in qualitative research (Kirk and Miller, 1986, Mason, 2002, Silverman, 2013).

Accordingly, many researchers have sought a compromise, proposing alternative measures of rigor which can be applied to qualitative research. One of the more commonly applied frameworks for considering the quality of qualitative research is Lincoln and Guba's concept of 'trustworthiness' (Lincoln and Guba, 1985). They suggest that trustworthiness should be measured using four criteria: credibility, transferability, dependability and confirmability. These criteria share many parallels with the concepts of reliability, validity and objectivity. The way in which these criteria were considered in relation to the current study are considered below.

Credibility

Credibility refers to the extent to which the findings can be said to reflect the reality of the participants' experiences.

The iterative process of data collection and analysis had a number of benefits for ensuring the credibility of the results as the study developed. The process of theoretical sampling and modifying interview guides creates a process of 'analytic induction', where concepts and ideas emerging from earlier interviews can be tested and refined – or indeed rejected – by continuously comparing the experiences of a diverse range of individuals (Silverman, 2011).

As the themes were developed gradually throughout the process, this allowed for a form of respondent validity called emergent validity or 'member checking'. During the last set of interviews, parents were occasionally asked some slightly more direct questions relating to the concepts and themes that had been highlighted from the analysis of previous interviews. The following quote (with the researcher's questions in bold) gives an example of this questioning:

What's the main reason, for you, for brushing her teeth?

It's just general hygiene isn't it? And their appearance. You wouldn't let them out of the door with muddy trousers, or food all over them and their hair all scruffy, and everything. So it's just part of that really.

And what about brushing in the evening?

Well she's brushing her teeth in the morning anyway, so there's that. But I suppose there's some benefit – it's getting rid of food that she's eaten, the bacteria, so it's stopping her teeth getting rotten in the long run, I guess.

So would you say there are different reasons for brushing in the morning and evening?

Oh yeah, of course there are.

This approach provided an opportunity to test the credibility of the emerging hypotheses among the population being studied. It is a more practical approach than returning to each participant with a summary of the findings, which was not considered feasible for the current study given limitations on time and resources.

A second consideration is whether participants in the study gave honest accounts of their behaviour. There is always a risk in both qualitative and quantitative research that participants will give 'socially acceptable' answers rather than being honest. Indeed, in this study, most of the participants were aware of the idea that they *should* brush their children's teeth regularly. The introduction to each interview was therefore designed to combat this to some extent by encouraging the participants to be as honest as possible and explaining that there were no right or wrong answers to any of the questions. Participants were assured that the interview and results were anonymous, and the interviewer made it clear that they were not a dental professional but rather a researcher with an interest in home toothbrushing. King and Horrocks also argue that an introduction and some basic opening questions provides an opportunity to establish

a level of rapport with the interviewee before moving on to ask key questions (King and Horrocks, 2010), which should lead to more open and honest answers. Finally, previous research has suggested an increased propensity for interviewees to feel a sense of anonymity when conducting interviews over the phone or in other non-face-to-face modalities (Joinson, 2001, Opdenakker, 2006), which should also lead to more honest accounts of toothbrushing behaviour.

The nature of qualitative work means that the researcher's own background is always likely to exert some degree of influence on the process of data collection, analysis and the formation of themes. Charmaz argues that "just as the methods we choose influence what we see, what we bring to the study also influences what we can see" (Charmaz, 2006). This risk of personal bias was mitigated against to some extent by collaboration and discussion of emerging ideas with the supervisory team during coding and analysis. Preliminary findings were also presented at research days and conference events, allowing others to provide feedback on the findings and to provide alternative viewpoints.

Transferability

Transferability refers to the extent to which the findings can be said to be applicable to other contexts. It is therefore similar to the concept of generalisability.

Due to the nature of the sampling techniques and sample size, qualitative research is less likely to generate findings which can be easily generalised to wider populations. As part of a larger mixed methods project, one of the aims of this study was to generate themes and concepts which might be further explored using quantitative means with a larger sample of parents.

In this particular study, the participants were purposely selected to be parents of young children resident in areas of high deprivation. As discussed in the literature review (Section 2.5.1), research suggests that parents from low-SES areas tend to brush their children's teeth less often, and so the study deliberately focused on this group. Although some deliberate variation was built into the sample through theoretical

sampling, the parents interviewed nonetheless represent a fairly homogenous group in terms of socio-economic status and geographic location. The findings reported here may not necessarily be applicable to parents of older children, for instance, or parents from less deprived areas. Future research may seek to expand on the findings here and explore, for instance, the extent to which day-to-day routines may differ between families from different socio-economic groups, and how this impacts on children's toothbrushing frequency and habit development.

The participants were also recruited on the basis of their children taking part in a supervised school toothbrushing scheme, and the questions about toothbrushing at home followed on from some questions about the child brushing in school. It is possible that parents may have had a heightened awareness of the importance of oral hygiene as a result of promotional materials sent home, or indirectly through their children mentioning the scheme.

The point at which to stop recruiting participants in a qualitative study is always a balance between pragmatism and the quest for 'theoretical saturation'. Sample sizes in qualitative research are rarely defined in advance, and can range from one person (a case study) to more than a hundred (Mason, 2002). In the current study, many of the interviews with parents lasted up to 60 minutes and sometimes up to 90 minutes. This created a lot of rich data, which took a long time to transcribe and to analyse. Importantly, as parents were purposely sampled to include a range of viewpoints (i.e., regular and irregular brushers; parents of slightly younger and slightly older children), it also meant that the themes which had been identified from the data were sufficiently well developed that subsequent interviews were not adding significantly different ideas or concepts.

As recruitment was overseen by the Community Dental Service staff, it was not possible to keep a complete record of how many parents were approached to take part in the study but declined to do so. This may introduce an element of bias to the sample of parents selected, whereby participants who were willing to be interviewed may differ

from the wider population in terms of looking after their children's teeth. The current study was concerned more with parents' individual experiences of brushing their children's teeth than estimating average levels of toothbrushing frequency, and some parents who brushed their children's teeth less often were purposely included in the sample. However, it is possible that the parents interviewed here were more likely to brush their children's teeth than the wider population, or at least have stronger views about oral health.

Finally, the presentation of numerous quotes from parents was aimed at providing a "thick description" (Creswell and Miller, 2000), and therefore sufficient context in order that other researchers are able to decide for themselves how far the results may be transferred to other settings.

Dependability

Dependability refers to the consistency with which the various research processes are conducted.

In the current study, each of the fifteen interviews were digitally recorded and transcribed in full by the interviewer to ensure that participants' perspectives were fairly and accurately represented. During the initial stages of analysis, a coding book was employed to allow a systematic and transparent approach to interpreting the data.

After the first batch of interviews had been analysed and coded, the researcher met with one of the project supervisors to read through the full interview transcripts and discuss the primary codes and themes that had been identified from these initial interviews. The purpose of this exercise was not to produce a complete consensus on the codes and themes, but rather to allow for the consideration of alternative perspectives and interpretations of the data and thus provide some degree of inter-rater (or internal) reliability (Silverman, 2013).

Confirmability

Confirmability refers to the extent to which the results reflect the participant's experiences, rather than the characteristics and preferences of the researcher.

One important consideration in the conduct of qualitative interviews and the subsequent interpretation of the data is the 'positionality' of the researcher. During an interview, the research is likely to be affected by the participant's perception of the interviewer. Gubrium and Holstein refer to qualitative interviewing as an 'interactional project' in which the interviewer and interviewee co-construct a narrative (Gubrium and Holstein, 2002). Hopkins argues that basic factors such as the way a researcher introduces themselves before an interview can have a dramatic effect on the type of information that the interviewee will be likely to share (Hopkins, 2007).

The researcher had some previous experience with conducting qualitative interviews, and was therefore aware of best practice approaches for conducting in-depth interviews. As the goal of the study was to generate novel ideas and understand parents' perspectives, particular importance was placed on asking open rather than closed questions, strategic use of silence to elicit more information and an emphasis on allowing interviewees to explain their thoughts without interruption (Gill et al., 2008).

Due to the iterative nature of the study design, the researcher was able to listen back to each interview soon after it ended and make written notes. These aided with identifying developing themes, but also allowed for reflection on the interviewer's role in the conversation. Regular note-taking and memos created during coding of the full transcripts allowed for further reflection and acted as a guide to improve future interviews. These exercises lead, for instance, to the use of better probing questions in subsequent interviews and a decrease in the number of closed questions.

4.4.4. Conclusions

The current study identified a number of themes and concepts which were of relevance to parents of young children when considering when and how often to brush their teeth

at home. Overall, they point to the idea that parents' oral health knowledge and beliefs are unlikely to be sufficient in explaining their decisions about when and how often they brush their children's teeth. There appears to be a need to consider wider factors such as differing rationales for brushing a child's teeth (both between different parents, and at different times of day), the effect of parents' home routines and the way in which parents' perceptions of what other people do might inform their own behaviour. These concepts have rarely been considered in relation to oral health care of children, and yet may be important to consider when designing oral health education messages or designing oral health interventions.

4.5. Chapter summary

This chapter reported on the first study of the PhD, based on a series of in-depth interviews with parents of young children. A series of themes were developed from the interview data, and these were discussed in relation to the existing literature. The limitations of the study were also considered.

The findings from this study informed the development of two further quantitative studies. The following chapter reports on the first of these studies, a questionnaire survey which was developed in order to explore some of the ideas and concepts generated from the interviews with a larger sample of parents.

5. STUDY 2 – PARENT QUESTIONNAIRE SURVEY

This chapter describes the second study of the PhD project, which involved a postal questionnaire survey completed by 297 parents of children aged 3-6 years old. As in the previous study (Chapter 4), parents were resident in areas of high socioeconomic deprivation in South-East Wales.

The questionnaire survey built on, and was informed by, the parent interviews which were described in Chapter 4. The aim of the survey was to empirically measure the various concepts and ideas highlighted in the parent interviews, and establish the extent to which they were related to when and how often parents brushed their children's teeth at home.

The *introduction* (Section 5.1) looks at the rationale for conducting the study and considers the aims and objectives of the work. The *method* section (Section 5.2) explains exactly how the survey was developed and administered, describes the study population and describes the way in which the data were analysed. The *results* section (Section 5.3) presents details of the survey participants, as well as the main findings from the study. This section includes illustrative graphs, summary data and bivariate and multivariate analyses which address the research aims and questions. Finally, the *discussion* section (Section 5.4) reflects on the key findings and considers how they compare to and add to the existing literature. It also presents a rationale for certain methodological decisions and considers the limitations of the study.

Two manuscripts based on this study have been accepted for publication in *Caries Research* and *Community Dental Health*. They are presented as Appendix 10 and Appendix 11

5.1. Introduction

5.1.1. Background

The previous study (Chapter 4) used a series of in-depth interviews to explore parents' decisions about when and how often they should brush their young children's teeth at home. The interviews identified some themes and concepts that have been relatively unexplored in oral health research, but have received relatively more attention within the wider health and psychology literature. These concepts included parents' short and long-term motivation for brushing their child's teeth, the influence of home routines on toothbrushing, parents' perception of social norms for toothbrushing frequency, and the extent to which parents described brushing their child's teeth as automatic or habitual.

Some of these concepts, such as toothbrushing routines, habits and motivation have been briefly discussed before by researchers using qualitative research methods to understand parents' ideas about their children's oral health (Huebner and Riedy, 2010, Cortes et al., 2012). Cortes and colleagues, for instance, interviewed parents of young Latino children in the greater Boston area of the United States. They reported that "parents indicated that establishing a routine helps making sure that their children practice good oral hygiene", and that some parents were aware of the importance of developing "enduring habits" (Cortes et al., 2012). Other researchers using qualitative research methods have noted that children and adolescents often see brushing their teeth as being important for cosmetic reasons rather than their long-term dental health (Dorri et al., 2009, Gill et al., 2011).

Despite these observations, there has been very little quantitative research attempting to define and measure concepts such as norms, routines, habits and toothbrushing motivation in relation to oral health and particularly to toothbrushing frequency. Consequently, the current study aimed to measure some of these concepts and explore their relationship to when and how often parents brushed their children's teeth at home.

Inductive, qualitative research is well suited to generating new ideas and themes in areas where there has been little previous work, and this approach was therefore suited to addressing the aims of Study 1 described in Chapter 4. However, the extent to which results from qualitative work can be generalised to larger populations is compromised by the sampling strategy and typically small sample sizes (Bryman, 2012). In contrast, quantitative methods such as questionnaire surveys allow data to be collected from a large number of people and, consequently, they can be used to explore the relationship between several concepts and ideas of interest.

5.1.2. Research aims and objectives

Aim

To measure the extent to which the various parental and family factors identified in Study 1 were related to the frequency and time of day that parents reported brushing their child's teeth at home.

Objectives

The results of interviews carried out with parents in Study 1 (Chapter 4) allowed for the formation of several specific objectives for the current study. These objectives were:

- (1) To establish the proportion of parents who report brushing their child's teeth less often than the recommended twice a day, or fourteen times a week
- (2) To establish whether there was any difference between the frequency with which parents brush their children's teeth in the morning and in the evening
- (3) To establish the frequency with which parents think an 'average' child has their teeth brushed at home each week
- (4) To establish whether parents' perceptions of the 'norm' for weekly brushing were related to how often they reported brushing their own child's teeth
- (5) To establish whether parents' perceptions of the 'norm' for weekly brushing affected how satisfied they were with their own child's brushing routine

- (6) To establish whether parents were motivated by different factors when thinking about brushing their child's teeth in the morning and in the evening
- (7) To establish whether there was a relationship between how often parents reported brushing their child's teeth, their motivation for brushing, the extent to which brushing was 'automatic' and the stability of day-to-day household routines

5.2. Methods

5.2.1. Study design

The themes and concepts developed through the parent interviews in Study 1 (Chapter 4) had not previously been studied in any detail within the field of oral health. As a result, there were no secondary data sources which were judged to be suitable for answering the study's research questions. Instead, primary data were collected via a series of postal questionnaire surveys sent to parents' home addresses, self-completed by participants and returned to the researcher in the post.

5.2.2. Study population

Sampling frame

The sampling frame for the study consisted of all parents whose children were participating in the national, supervised toothbrushing scheme (Designed to Smile) via their nursery school or school, in the Abertawe Bro Morgannwg University Health Board (ABMUHB) in South-West Wales. ABMUHB covers the two local authorities of Swansea and Neath Port Talbot. Designed to Smile is deliberately targeted at schools and nurseries in areas of high socio-economic deprivation. The 'catchment areas' of these nurseries and schools means that parents whose children take part in the scheme are themselves typically resident in deprived areas. Designed to Smile participation therefore acted as a proxy for socio-economic deprivation.

A total of 127 schools and nurseries from ABMUHB were participating in the scheme at the time of the study (65 in Swansea, 62 in Neath Port Talbot). The Community Dental Service (CDS), who are responsible for the day-to-day operation of the scheme, provided a full list of participating nurseries and schools in the area.

In order to achieve the required sample size of 289 parents (see Figure 5.1: Study 2: Summary of the sampling frame used

Sample size calculation below), twenty schools and nurseries were chosen at random, using stratified random sampling to ensure a mixture of schools from the Swansea and Neath Port Talbot areas (Figure 5.1). Invitation letters, information sheets and consent forms were sent to parents of all 625 children who were aged 3-6 years old (in nursery, reception or Year 1) in the twenty selected schools and nurseries.

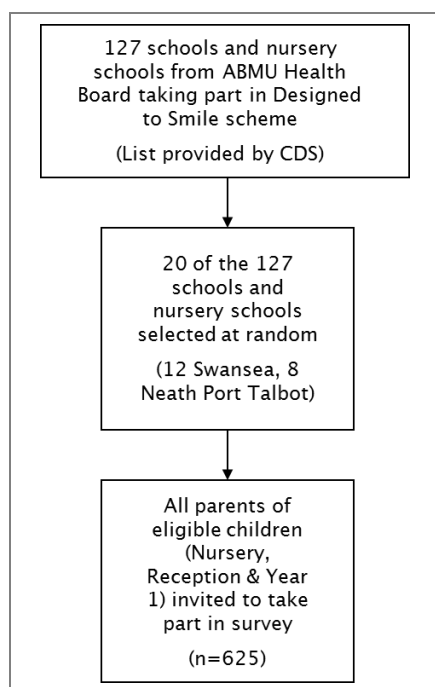


Figure 5.1: Study 2: Summary of the sampling frame used

Sample size calculation

The primary outcome measure for the survey was the frequency with which parents reported brushing their child's teeth each week. Based on representative UK studies of five-year old children (White et al., 2006), it was estimated that approximately 75% of the parents surveyed would report brushing their child's teeth twice daily, with the rest reporting less frequent brushing. Using the software package G*Power (Faul et al., 2007), it was calculated that in order to determine the expected proportion to within $\pm 5\%$ with a 95% confidence interval (2-sided), a final sample of at least 289 parents was required.

Based on a response rate of 55% to the pilot study (Section 5.2.4), and allowing for some margin for error, 625 parents were invited to take part in the study in order to achieve the required sample size of 289.

5.2.3. Materials

A six-page questionnaire survey was developed to address the study aims and objectives. The survey was designed to measure the frequency with which parents reported brushing their child's teeth, as well as the various ideas and concepts which had been identified through the qualitative study and through a review of the relevant literature.

An initial draft of the questionnaire survey and covering letter was circulated to and approved by staff from the Community Dental Service and a consultant in Dental Public Health, before being piloted with members of the population being studied.

5.2.4. Piloting work

The questionnaire was piloted with parents in two stages. Firstly, by conducting a form of cognitive interviewing called 'think aloud' testing, where the researcher sat with participants and asked them to go through the questionnaire while verbalising their thought processes (Willis, 2005). Secondly, the questionnaire and associated materials were sent to a sample of 55 parents for completion. In both cases, participants were sampled to ensure their similarity with parents from the main sampling frame.

Think aloud testing

The researcher sat with six individual participants in their respective homes as they filled out a pilot version of the full questionnaire survey. Participants were encouraged to verbalise their thought process while they read instructions and completed each question, and were encouraged to provide general feedback at the end, with their observations noted by the researcher. This stage of the testing allowed for the assessment of:

- participants' understanding and interpretation of the instructions and questions
- the 'flow' of the questionnaire, between questions and sections
- the length of time that the questionnaire took to complete

- the extent to which participants maintained their interest and attention during questionnaire completion.

The observations resulted in a number of changes to the questionnaire, including the simplification of 'instruction boxes' provided before sub-sections, re-wording of various questions and the re-ordering of different sections in the survey.

For example, a question about how many older and younger siblings their child had was split in to two separate questions when it became clear that parents had difficulty answering the question accurately. Similarly, a question asking how often a parent brushed their child's teeth in a normal 'school week' (Monday-Friday) caused confusion, and was changed to ask about a normal, seven day week (Monday-Sunday). In other cases, parents were judged to have interpreted and answered questions correctly and no changes to instructions or wording were felt necessary. Overall, parents were satisfied with the length of the questionnaire.

Finally, many of the parents objected to the inclusion of questions about their own demographic details (e.g., their age, gender, education level), feeling that these questions were not relevant to a survey about their child's toothbrushing habits. Parents explained that they would be reluctant to give such information, and may be less inclined to complete the survey if these questions were included, even if the questions were optional and appeared later in the survey. To limit any impact on the survey response rate, demographic details were therefore only collected in relation to children. No demographic questions were asked of parents.

Pilot survey

The second stage of piloting involved sending consent forms to a sample of 55 parents from one randomly chosen school in the ABMUHB area. The school was subsequently excluded from the final sampling frame. The procedure mirrored used for the main study and participants were not told that the survey was being used as a pilot.

This stage of the piloting allowed for the assessment of questions or sub-questions which were regularly skipped (item non-response) and testing the assumptions made about response rates in determining the sample size for the main study (Gillham, 2000).

Thirty parents returned a completed questionnaire, providing a response rate of 55%. As a result of the pilot testing, a number of additional changes were made to the questionnaire and covering letter. These changes are summarised in Table 5.1.

Observation from pilot survey	Changes made to questionnaire survey
Some parents ticked only one row on the Self-report Habit Index	Made the completion instructions more clear and emphasised need to tick one box in each row
A number of parents skipped the delay discounting questions	Made the completion instructions more clear and moved this question to the end of the survey
Some parents answered only the morning question part of the toothpaste choice vignette	Separated this item into two distinct questions, one for morning and for evening. Added a gap between the questions, and gave each question a different question number
Some questionnaires were returned in participant's own envelopes at own cost	Re-worded and emphasised the instructions for returning a questionnaire survey in the pre-paid envelop provided
Some parents incorrectly skipped questions or answered questions that they didn't need to	Altered routing instructions to be more clear, adding arrows from answer boxes
General observation that parents had missed certain questions or answered some questions incorrectly	Formatted all instruction boxes, simplified the wording and made the boxes more distinct from the questions and answers

Table 5.1: Study 2: Summary of changes made to questionnaire and covering letter following pilot work

Changes included the removal of several questions deemed to be superfluous or repetitive, clearer instructions on how to return the questionnaire using the pre-paid envelope and improvements to the instructions for questions in the survey where certain items had been regularly skipped.

Several parents only answered one element of a multi-item measure of habit strength, for instance, and so the instructions for that particular question were made clearer.

Conversely, questions which had concerned the research team as potentially too complex were answered by the vast majority of participants in the correct way.

5.2.5. Measures

The final version of the questionnaire survey is shown in Appendix 4. The following concepts were measured:

Outcome variables

Child's weekly toothbrushing frequency

The previous, qualitative research study lead to two observations about how parents described the frequency with which they brushed their child's teeth: firstly, that morning and evening brushing were considered independent events, and occurred at different frequencies; and secondly, that many parents talked about 'usually' brushing their child's teeth 'twice a day' but then later introduced caveats, explaining for instance that they missed evening brushing a few times a week.

As a result, toothbrushing frequency was assessed by asking four separate questions. The first question simply asked parents how often they usually brushed their child's teeth at home *each day*. The second question asked how often the parents brushed their child's teeth at home *each week*. The third and fourth questions asked how often parents brushed their child's teeth in the morning each week, and how often they brushed their child's teeth in the evening each week.

The answers given for morning and evening brushing frequency (weekly) were summed and compared to answers given for overall brushing frequency (weekly). Internal consistency was good (Cronbach's alpha, $\alpha=.94$).

Independent variables

Perceived descriptive norm

In order to measure parents' perceptions of what other parents and children did in relation to home toothbrushing, participants were asked to estimate how often they thought an 'average' child in their son or daughter's school year would have their teeth brushed at home each week. The question asked 'What do you think is the average number of times that a child in your child's school year brushes their teeth (or has their teeth brushed) each week?'

Parental satisfaction with child's toothbrushing routine

Parental satisfaction with their child's toothbrushing routine was measured via a single-item five-point Likert scale question, assessing the extent to which parents agreed or disagreed with the statement "I am happy with how often my child has their teeth brushed at home in a typical week". The item was scored from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating higher levels of satisfaction.

Strength of parent's habit for brushing child's teeth

The extent to which parents felt that brushing their child's teeth to be 'habitual' was measured using the validated Self-Report Habit Index (Verplanken and Orbell, 2003). Habit strength was recorded separately for morning brushing and evening brushing.

The twelve-item SRHI measures the degree to which an action is 'automatic' (Figure 5.2). Statements used the stem 'Making sure my child brushes their teeth in the [morning/evening] is something...' and options included 'that I do automatically', 'that I do without thinking' and 'that belongs to my daily routine'. Responses to each statement were scored on a five-point scale and ranged from 'strongly agree' (+2) to 'strongly disagree' (-2).

Consistent with previous cross-sectional studies, two items ('I do frequently' and 'I have been doing for a long time') were excluded from the analysis to avoid artificially inflating

the habit-behaviour relationship (de Bruijn, 2010). Responses to the ten remaining items were summed and separate scores for morning and evening habits were calculated for each parent, ranging from 20 (strongest habit) to -20 (weakest habit).

Internal consistency was good for both morning (Cronbach's alpha, $\alpha=.95$) and evening habit strength ($\alpha=.98$).

<i>Brushing my child's teeth or making sure they brush their teeth IN THE MORNING is something....</i>	Strongly agree ▼	Agree ▼	Neutral ▼	Disagree ▼	Strongly disagree ▼
I do frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do automatically	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without having to consciously remember	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that makes me feel weird if I don't do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without thinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that would require effort not to do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that belongs to the daily routine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I start doing before I realise I'm doing it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would find hard not to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have no need to think about doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that's typically 'me'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have been doing for a long time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 5.2: Study 2: Example of Self-Report Habit Index questions used in the parent survey

Parents' motivation for brushing child's teeth

Parents were presented with a vignette in which they were asked to choose between one of five fictional types of toothpaste to use for brushing their child's teeth (Figure 5.3).

They were asked to select a type of toothpaste to use for brushing their child's teeth in the morning and then a toothpaste to use for brushing their child's teeth in the evening. The five choices varied according to the proportion of two fictional ingredients, 'fresh' (has cosmetic benefit, but no clinical benefit) and 'health' (has clinical benefit, but no cosmetic benefit). Parents could choose between toothpastes containing 0% Fresh/100% Health, 25% Fresh/75% Health, 50% Fresh/50% Health, 75% Fresh/25% Health or 100% Fresh/0% Health.

28 If you had the following five choices of toothpaste to use *in the evening*, which *one* would you choose to use for your child?

Please tick one box only

	FRESH		HEALTH	Choose <i>one</i> type of toothpaste to use in the evening
(1)	100%	FRESH	0%	<input type="checkbox"/>
(2)	75%	FRESH	25%	<input type="checkbox"/>
(3)	50%	FRESH	50%	<input type="checkbox"/>
(4)	25%	FRESH	75%	<input type="checkbox"/>
(5)	0%	HEALTH	100%	<input type="checkbox"/>

Figure 5.3: Study 2: Example 'toothbrushing motivation' question from the parent survey

The 'fresh' and 'health' concepts were based on the various explanations that parents offered for brushing their children's teeth in the previous study (Chapter 4). They represented two sides of a theoretical continuum, ranging from purely short-term perceived benefits ("clean teeth", "fresh breath") to more long-term perceived benefits of toothbrushing ("keeps their teeth healthy", "prevents fillings").

Stability of daily routines

To measure the extent to which home routines in the morning and evening were stable from day-to-day, parents answered a five-item measure indicating whether certain household events ('waking up in the morning', 'having breakfast', 'having an evening meal', 'going to bed') occurred at consistent times throughout a normal week (Figure 5.4).

IN THE MORNING.... (Mon-Fri)	Always the same time ▼	Usually the same time ▼	Sometimes the same time ▼	Rarely the same time ▼	Never the same time ▼	Not applicable ▼
Waking up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having breakfast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a wash	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting dressed for school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leaving the house for school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IN THE EVENING....(Mon-Fri)	Always the same time ▼	Usually the same time ▼	Sometimes the same time ▼	Rarely the same time ▼	Never the same time ▼	Not applicable ▼
Getting home from school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having dinner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a wash before bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting changed for bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going to bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 5.4: Study 2: Example 'routine stability' question from the parent survey

The items of the scale were based on data from the parent interviews (Chapter 4), where various daily events which were identified as often being closely linked with toothbrushing in the home.

Responses were scored on a five-point scale, ranging from 'always occurs at the same time' (+2) to 'never occurs at the same time' (-2). Separate scores were calculated for morning and evening routines for each parent, with scores ranging from 10 (most stable routine) to -10 (least stable routine).

Internal consistency for the items on both the morning and evening scale was good (morning: $\alpha=.78$; evening: $\alpha=.88$).

Delay discounting / time preference

Parents' individual level of delay discounting – their preference for immediate rewards relative to future rewards – was assessed with a three-item measure previously employed by Foreman-Peck and Moore (Foreman-Peck and Moore, 2010). Parents were presented with a hypothetical situation in which they were told that they had won a lottery prize of £87, and asked how much money they would immediately exchange

their ticket for if they had to wait x days to collect their prize, where x was equal to 7, 30 and 90 days.

Control variables

Perceived cost of toothbrushing

The cost of toothbrushing was rarely mentioned by parents in the interviews reported in Chapter 4. However, because parents were deliberately recruited from areas of high socio-economic deprivation, it was considered important to control for the possibility that the frequency with which parents brush children's teeth may be affected by economic considerations such as cost.

Parents were therefore asked two separate questions, where they indicated how expensive they thought it was to purchase toothbrushes and toothpaste for their children. Answer options were on a Likert-scale, with five choices ranging from 'very expensive' to 'very cheap'.

Socio-demographic variables

Demographic details included the child's age and gender, the age at which the parent first started brushing the child's teeth and the number of other siblings in the family.

Socio-economic status was assigned using quintiles from the Welsh Index of Multiple Deprivation (Welsh Government, 2011), derived from parents' home post-code. Quintiles ranged from 'Least deprived' (WIMD=1) to 'Most deprived' (WIMD=5).

Designed to Smile questions

Four questions relating to the effect of participating in the Designed to Smile scheme were also included in the questionnaire survey. The answers to these questions were used as part of a wider process evaluation of the scheme, but were considered outside of the scope of the current study and therefore not included in the analysis reported here.

5.2.6. Procedure

Recruitment of parents

All eligible parents were given a two-page information sheet and a consent form (Appendix 3) by classroom teachers. In line with the Welsh Language Act (1993), all forms were provided in both English and Welsh language.

Parents who wished to take part in the study were asked to complete the consent form, including their name, their child's name, their home address, a contact telephone number and their preferred language of correspondence (English or Welsh). Forms were then either returned to a CDS staff member or the classroom teacher in a sealed envelope. After three weeks, all of the completed consent forms were sent in the post to the researcher (Figure 5.5).

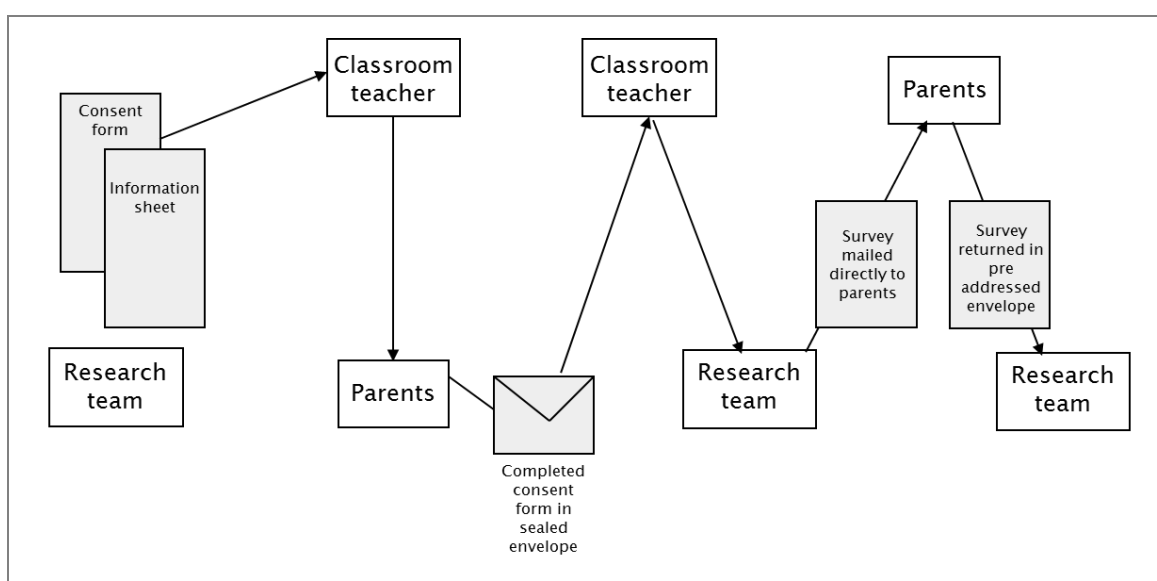


Figure 5.5: Study 2: Flow diagram summarising the recruitment process for the parent survey

Mailing questionnaires

Using the contact details provided in the consent forms, all consenting parents were mailed a questionnaire survey, as well as a covering letter and a pre-paid and pre-addressed return envelope.

Both the covering letter and envelope were personalised using the parent's name provided in the consent form. Each survey was numbered using a unique ID for

tracking purposes, and names on envelopes and covering letters were checked against the ID number before being sent out.

Following up non-respondents

Returned questionnaires were logged in a Microsoft Excel spreadsheet, noting the unique ID of the survey. The response log allowed for the tracking of non-respondents and therefore targeted follow up mailings.

Figure 5.6 gives an overview of the process for contacting non-respondents.

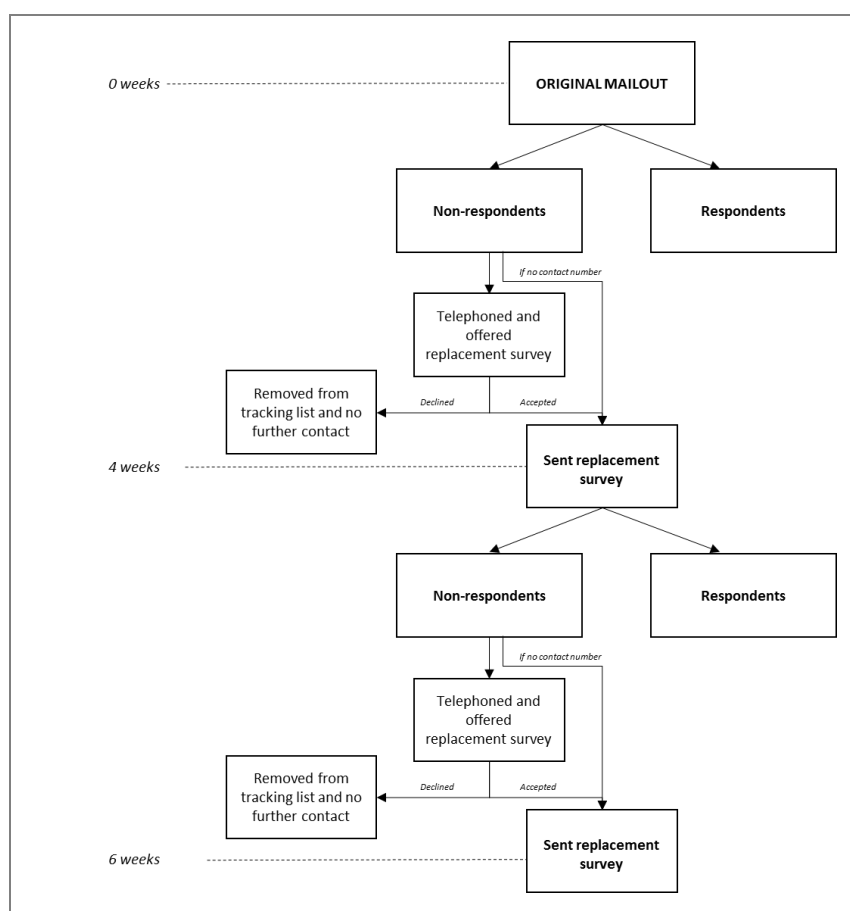


Figure 5.6: Study 2: Flow diagram summarising the process for following up survey non-respondents

After four weeks, all non-respondents who had provided a contact telephone number were contacted by telephone and offered a replacement questionnaire. Where no contact number was provided, a further copy of the questionnaire and follow-up covering letter were mailed. If parents explained that they no longer wanted to take part in the study, this was recorded on the response log and they were not contacted further.

Two weeks later, a second telephone call was made to all remaining non-respondents, again offering them a replacement questionnaire if needed. For those who had not provided a contact number, a second replacement questionnaire was sent in the post.

5.2.7. Data analysis

Data analysis was conducted using SPSS v20 (IBM, 2011) and Stata v13 (StataCorp, 2013)

Demographic data was explored using descriptive data. The distribution of outcome and independent variables was explored graphically, and are presented in the results to illustrate the range and pattern of scores for each variable.

Bivariate analysis

A number of group differences were explored: to assess any difference between morning and evening brushing frequency; to assess any difference between how often parents reported brushing their own child's teeth and how often they thought an 'average' child had their teeth brushed; and to assess any difference in parents' motivation for brushing children's teeth in the morning and in the evening. As the majority of these variables were not normally distributed (Shapiro-Wilk test, $p < 0.05$), group differences were assessed using the non-parametric Wilcoxon signed-rank test, with Z scores reported.

A number of bivariate tests were conducted to explore the relationship between children's weekly toothbrushing frequency (morning, evening and overall) and various family, parental and socio-demographic factors. These were conducted using a Spearman's rank correlation coefficient, a non-parametric test of the relationship between variables.

The relationship between independent variables and weekly toothbrushing frequency was explored graphically, and these are presented in the results. In most instances, continuous variables were displayed in groups of two or three categories for ease of interpretation, and error bars displayed showing the standard error.

Multivariate analysis

An ordinal logistic regression was carried out to explore factors associated with parents' satisfaction with their child's weekly toothbrushing frequency, measured by their level of agreement on a five-point Likert scale with the statement "I am happy with how often my child has their teeth brushed each week". A social comparison score was calculated for each parent, using the difference between how often they reported brushing their own child's teeth each week and how often they thought the average parent brushed their child's teeth each week. For example, a parent who reported that their child brushed their teeth 14 times per week, and estimated that an average child brushed their teeth 10 times a week would be given a score of +4.

Finally, a number of multivariate analyses were conducted to explore the extent to which children's weekly toothbrushing frequency (morning, evening and overall) was independently associated with parental, family and socio-demographic variables.

Morning, evening and overall weekly brushing frequency were not normally distributed (Shapiro-Wilks, $p < 0.05$). Instead, each of these variables could be described as 'count' data, comprising of values which were whole integers (1, 2, 3, etc.), where negative values were not possible (Atkins and Gallop, 2007). The default option for multivariate analysis with a continuous dependent variable is simple linear regression, using the ordinary least squares (OLS) method of estimation. However, one of the central assumptions of OLS regression is that the dependent variable and its residuals are normally distributed, which is highly unlikely with count data (Cohen, 2003). As a result, using a linear regression model would likely have resulted in biased standard errors and unrealistic coefficients and so increase the risk of making Type I errors (Hutchinson and Holtman, 2005, Coxe et al., 2009)

Instead, weekly brushing frequency was therefore transformed to 'missed weekly brushing sessions', representing the number of times a parent 'missed' brushing their child's teeth compared to the fourteen times per week recommendation. For example, a parent who brushed their child's 10 times would have a value of 4 for missed weekly

brushing frequency, whereas a parent who brushed their child's teeth 14 times would have a value of 0. For morning and evening brushing frequency, 'missed weekly brushing sessions (morning)' and 'missed weekly brushing sessions (evening)' represented the number of times a parent missed brushing compared to the 7 times per week recommendation. The resulting variables matched a Poisson distribution, but were over-dispersed (the variance exceeded the mean). Therefore, a form of Poisson regression called Negative Binomial regression was used. Poisson regression is considered more appropriate for data with a Poisson distribution, and Negative Binomial regression is a specialised form of this regression which makes no assumptions about dispersion (Cameron and Trivedi, 2013).

Incident Rate Ratios (IRR) were reported, as well as the 95% confidence intervals. Incident Rate Ratios can be interpreted in a similar way to Odds Ratios. In this instance, the outcome variable was the number of times parents missed brushing their child's teeth in the course of a week. An IRR of 1.25, for instance, would mean that each one unit increase in the selected variable would be associated with a 25% increase in the rate of missed weekly brushing sessions. An IRR of 0.75 would mean that each one unit increase in the variable would be associated with a 25% reduction in the rate of missed brushing sessions.

Independent variables such as habit strength, routine stability and parent's estimates of brushing norms were kept as continuous variables. As a result, IRRs typically refer to the expected change in the outcome measure (weekly brushing frequency) per one unit increase in the variable being explored. These are interpreted further in the text.

For the purposes of the multivariate analysis, the cost of toothbrushes and toothpaste variable was dichotomised: parents who indicate that either toothbrushes or toothpaste were 'fairly expensive' or 'very expensive' were combined into one group and compared against all other parents. Similarly, because the sample was skewed towards those from more deprived areas, the socio-economic status variable was dichotomised to compare those from the most or next most deprived quintiles of the

Welsh Index of Multiple Deprivation (WIMD = 4-5) with those from the other three quintiles (WIMD = 1-3).

Delay discounting questions

As a result of high levels of item non-response, three questions asked to parents to ascertain their 'delay discounting' level (questions 27-29) were excluded from the analysis.

5.2.8. Research ethics

Ethical approval for the questionnaire survey study was provided by the National Health Service, National Research Ethics Committee, East Midlands (12/EM/0070) with Cardiff University acting as a sponsor. The committee approved all of the research materials, including the information sheet, consent form, questionnaire survey and covering letter. The approval letter is shown in

Appendix 5.

All participants gave informed consent before being sent a survey, and all were assured that they could withdraw their participation at any point during the study. All personal information provided in the consent forms were stored in a password-protected spreadsheet held on a secure University server, and were accessed only by the researcher. Questionnaire data were stored in a separate database, with no personally identifiable data included.

5.3. Results

5.3.1. Response rate

In total, 297 of the 625 eligible parents returned completed and usable surveys, comprising a 48% response rate. Socio-economic status data were available for an additional 190 non-respondents who completed consent forms but did not return a survey (Figure 5.7).

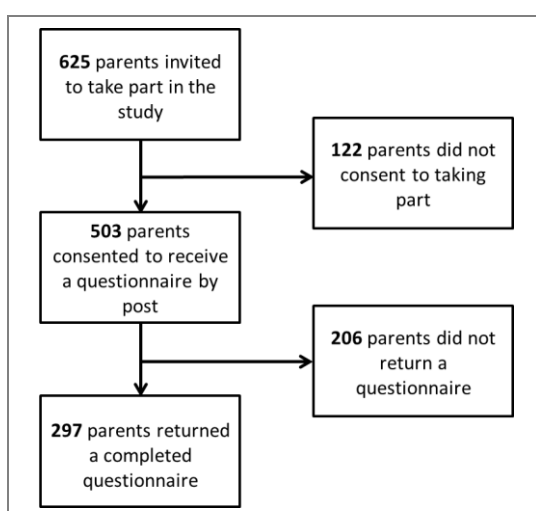


Figure 5.7: Study 2: Flow chart summarising response rate for the parent survey

A comparison was made between the distribution of deprivation quintiles among respondents and consenting non-respondents (Table 5.2). A chi-square analysis showed that there was no significant difference ($\chi^2 = 6.42$, $p=0.17$) between the two groups in terms of socio-economic status measured by Welsh Index of Multiple Deprivation quintile.

WIMD quintile	Respondents (n=297)		Consenting non-respondents (n=190)	
	N	%	N	%
WIMD = 5 (most deprived)	102	35.5	86	45.3
WIMD = 4	83	28.9	53	27.9
WIMD = 3	66	23.0	33	17.4
WIMD = 2	25	8.7	10	5.3
WIMD = 1 (least deprived)	11	3.8	8	4.2

Table 5.2: Study 2: Comparison of respondents and consenting non-respondents, by distribution of WIMD quintiles

5.3.2. Demographic details

Table 5.3 summarises the key socio-demographic details of the children that parents were surveyed about. Baseline figures vary slightly for each variable due to small levels of item non-response. Children were aged between 3 and 6-years old, with a mean age of 59.3 months, just under 5 years. The majority of the parents surveyed were resident in areas of high socioeconomic deprivation. On average, parents began brushing their child's teeth when the child was just under twelve months old.

Variable	N	Mean	SD	Min	Max
Child's age (months)	290	59.3	13.6	38	82
No. of younger siblings	289	0.5	0.6	0	3
No. of older siblings	291	0.8	0.9	0	6
Child's age when parent began brushing their teeth (months)	285	11.5	6.8	2	54
Variable	N	%			
Child's gender					
Male	139	47.3			
Female	155	52.7			
Socioeconomic status (deprivation quintile, WIMD)					
Most deprived	102	34.7			
Next most deprived	83	28.2			
Median	66	22.4			
Next least deprived	25	8.5			
Least deprived	11	3.7			
Unknown	7	2.4			

Table 5.3: Study 2: Demographic details of survey respondents.

5.3.3. Toothbrushing frequency

Overall weekly brushing frequency

Across the sample, the proportion of parents who reported brushing their child's teeth 14 times per week was 71.8% (95% CI: 66.4-76.6%, n=211). The average number of

times that parents reported brushing their child's teeth at home was 12.5 times per week (standard deviation = 2.5), with responses ranging from 4 to 14 times per week. Figure 5.8 shows the distribution of reported weekly brushing frequencies among the respondents.

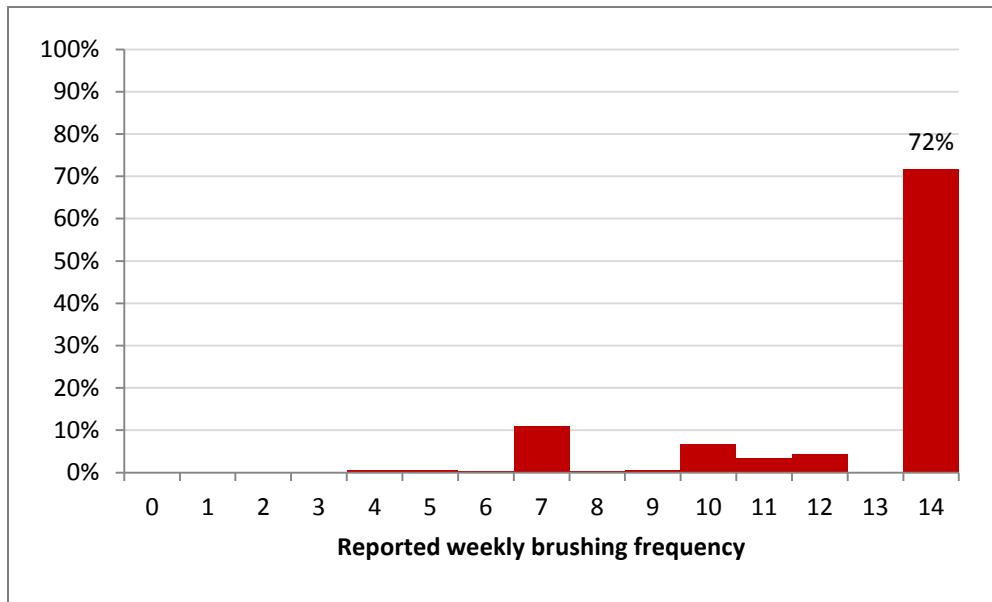
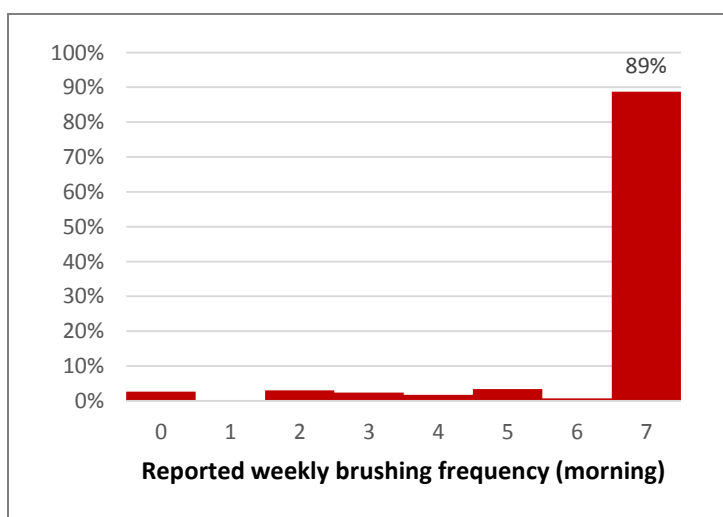


Figure 5.8: Study 2: Distribution of reported weekly brushing frequency

Morning and evening brushing

Parents were asked how often they brushed their child's teeth in the morning over the course of a normal week, and then asked separately how often they brushed their child's teeth in the evening (Figure 5.9). Overall, parents reported brushing their children's teeth significantly more often in the morning (mean (M)=6.57, standard deviation (SD)=1.39) compared to the evening (M =5.99, SD =2.15) (Z =-3.67, p <0.001).



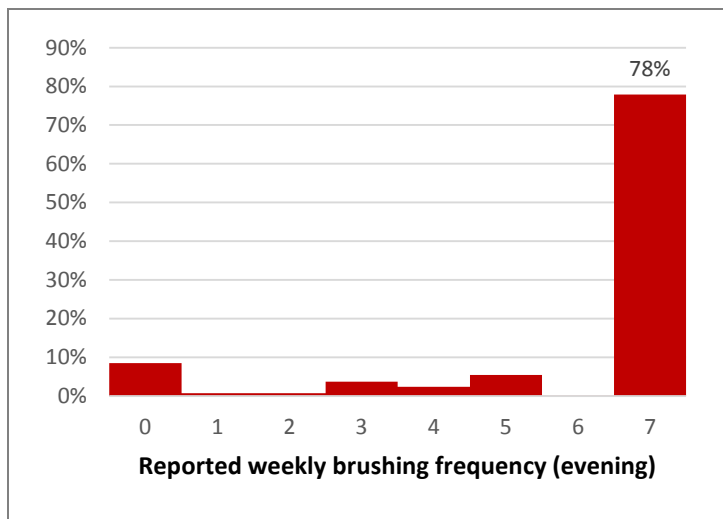


Figure 5.9: Study 2: Distribution of reported weekly brushing frequency in the morning, and in the evening

5.3.4. Social norms and social comparison

Parents' estimates of how often other children had their teeth brushed (perceived norm)

The mean of parents' estimated norm for weekly brushing was 10.5 ($SD = 3.1$) times per week, with estimates ranging from 2 to 14 times per week. Figure 5.10 shows the distribution of parents' perceived descriptive norms for weekly brushing.

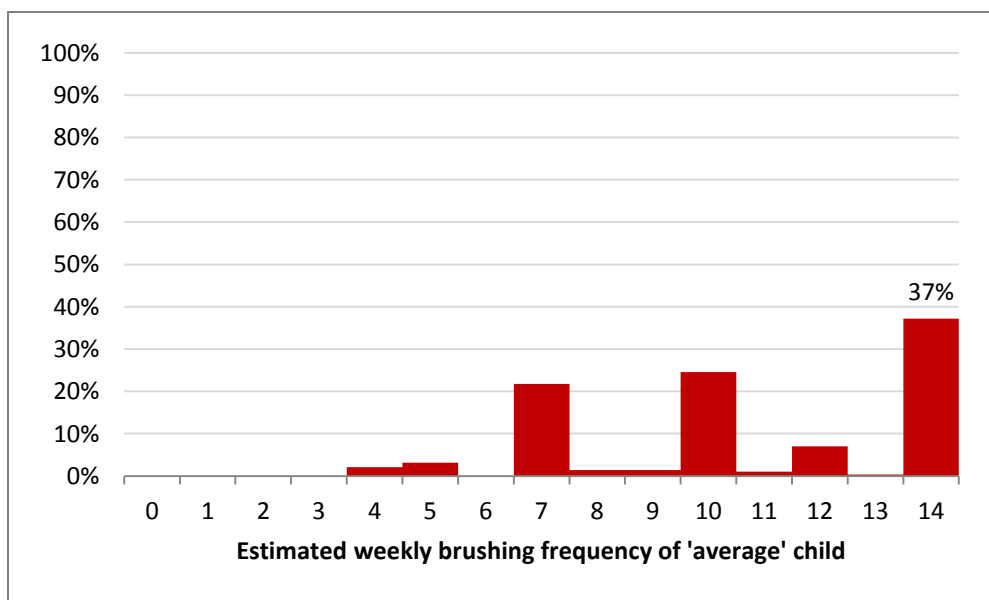


Figure 5.10: Study 2: Frequency distribution of parents' estimates of an average child's weekly brushing frequency

The distribution of social comparison scores is shown in Figure 5.11. The social comparison score was the difference between how often parents reported brushing

own child's teeth each week and their estimate of how often an 'average' child has teeth brushed each week

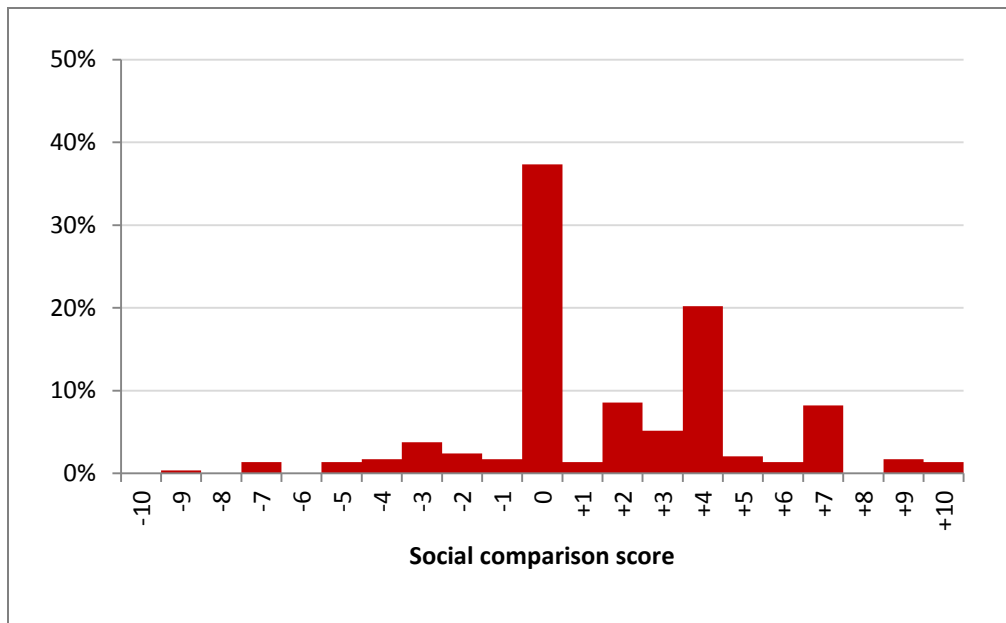


Figure 5.11: Study 2: Distribution of social comparison scores.

Half of the parents (50%, $n=146$) thought that they brushed their own child's teeth more often than the average parent, while 38% ($n=109$) thought their child's brushing routine was equal to the average. Only 12% ($n=37$) of parents believed that their child's routine was worse than average.

A Wilcoxon signed-rank test confirmed that, across the sample, there was a statistically significant discrepancy between the frequency with which parents reported brushing their own child's teeth and their estimates of how often their peers did ($Z=-8.078$, $p<0.001$). Overall, parents tended to believe that their own child had their teeth brushed more often than an average child.

Bivariate analysis

Table 5.4 shows a Spearman correlation matrix for parents' reports of how often they brushed their own child's teeth each week (weekly brushing frequency), their perception of how often an average child has their teeth brushed each week (perceived norm) and a number of socio-demographic variables.

Variable	1	2	3	4	5	6	7
1: Weekly brushing frequency	-						
2: Perceived norm	0.36**	-					
3: WIMD deprivation quintile (higher, = more deprived)	-0.23**	-0.14*	-				
4: Child's age (months)	-0.05	0.11	0.06	-			
5: Child's age when parent began brushing (months)	-0.05	-0.07	0.08	0.02	-		
6: No of younger siblings	0.06	0.07	0.02	0.10	0.02	-	
7: No of older siblings	-0.04	0.07	0.10	0.10	-0.06	-0.14*	-

Table 5.4: Study 2: Correlation matrix for weekly brushing frequency (* $p < 0.05$, ** $p < 0.001$)

There was a significant, positive relationship between how often parents estimated an 'average' child would have their teeth brushed each week and how often they reported brushing their own child's teeth each week ($r_s = 0.36$, $p < 0.01$). There was also a significant inverse relationship between how often parents reported brushing their child's teeth and their socio-economic status as assessed by deprivation quintiles of WIMD ($r_s = -0.23$, $p < 0.01$). Higher deprivation scores were associated with less frequent brushing. Weekly brushing frequency was not significantly associated with any of the other demographic variables.

Figure 5.12 illustrates the relationship between parents' perceptions of the norm for weekly brushing and how often they reported brushing their own child's teeth each week. Parents who thought that the norm for brushing was relatively low (between 0

and 9 times per week) reported brushing their child's teeth 10.9 times per week, compared to 13.4 times per week among parents who thought the norm was relatively high (12-14 times per week).

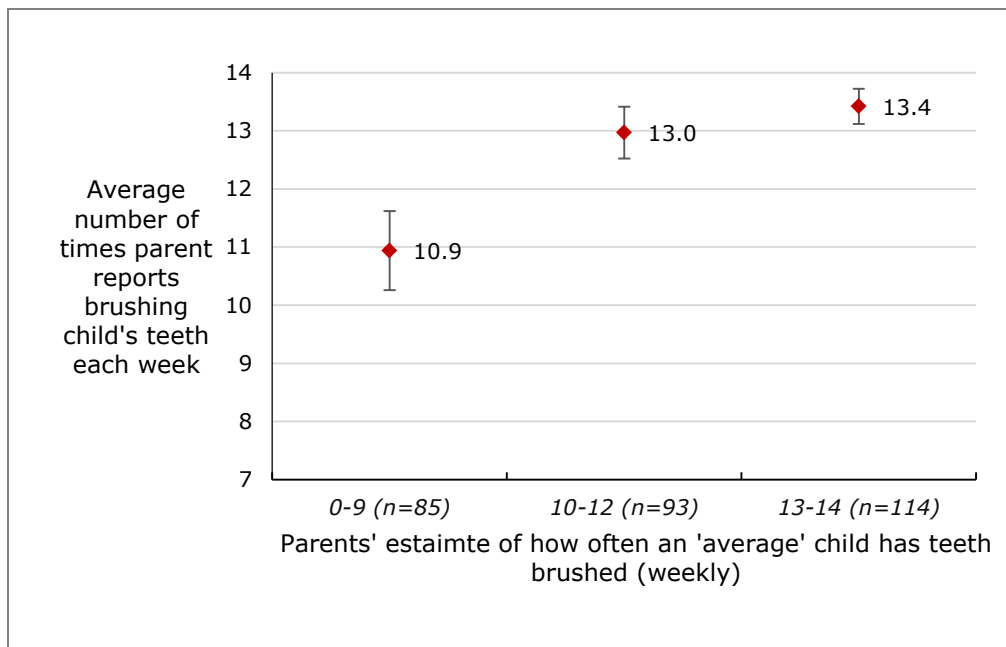


Figure 5.12: Study 2: Average number of times parents brush own child's teeth according to their perceived norm for weekly brushing, with 95% confidence intervals

Multivariate analysis – predicting missed weekly brushing sessions

A multiple regression analysis was carried out to explore factors which independently predicted the number of times that parents missed brushing their child's teeth in the course of a normal week (Table 5.5).

Variable	Model 1 (Unadjusted)	Model 2 (Adjusted)	Model 3 (Adjusted)
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Parent's perceived descriptive norm for weekly brushing (per one unit increase)	0.82 (0.75–0.89)**	0.81 (0.74-0.89)**	0.83 (0.75-0.91)**
Child's age when parent started brushing their teeth (per month increase)		1.00 (0.95-1.04)	1.00 (0.95-1.05)
Parent's perceived cost of toothbrushes and toothpaste			
<i>Not expensive</i>		1.00 (ref)	1.00 (ref)
<i>Fairly expensive/ very expensive</i>		1.40 (0.75 – 2.63)	1.13 (0.60 – 2.15)
Child's age (per month increase)			1.02 (0.99-1.04)
Child's gender			
<i>Female</i>			1.00 (ref)
<i>Male</i>			1.41 (0.78-2.53)
Number of siblings in family (per one sibling increase)			0.91 (0.67-1.23)
Socio-economic status			
<i>WIMD=1-3 (less deprived)</i>			1.00 (ref)
<i>WIMD=4-5 (more deprived)</i>			2.31 (1.20-4.49)*

Table 5.5: Study 2: Negative binomial regression, predictors of child's weekly brushing frequency (* $p < 0.05$, ** $p < 0.001$)

In the unadjusted model (Model 1), each one unit increase in a parents' estimate of how often an 'average' child had their teeth brushed each week was associated with an 18% decrease in weekly missed brushing sessions (IRR=0.82, $p < 0.0001$). Controlling for potential confounders (Model 2 and Model 3) did not change the estimates noticeably. In the final model, having controlled for a parent's perception of the cost of toothbrushing, the child's age when a parent first started brushing their teeth and a number of socio-demographic variables, each one unit increase in a parent's perceived norm was associated with a 17% decrease in the number of times they missed

brushing their own child's teeth each week (IRR=0.83, $p<0.0001$). There was therefore a significant independent association between parents' perceptions of the 'norm' for weekly brushing and the number of times they reported brushing their own child's teeth.

Parents from more socio-economically deprived areas (WIMD = 4 or 5) were expected to miss more than twice the amount of brushing sessions compared to those from less deprived areas (IRR=2.31, $p<0.05$). A parent's perception of the cost of toothpaste and toothbrushes and demographic factors such as the child's age, gender or number of siblings were not independently associated with the number of missed weekly brushing sessions.

5.3.5. Parental satisfaction with child's toothbrushing routine

Overall, 75% of parents either agreed or strongly agreed that they were happy with their child's brushing routine (Table 5.6).

"I am happy with how often my child's teeth are brushed each week"	N	%
Strongly agree	141	48.0
Agree	80	27.2
Neither agree nor disagree	31	10.5
Disagree	29	9.9
Strongly disagree	13	4.4

Table 5.6: Study 2: Summary of parents' responses to toothbrushing satisfaction question

Bivariate analysis showed that there was a significant positive correlation between a parent's social comparison score (how much better or worse they thought their child's brushing routine was compared to the average) and their satisfaction with their child's brushing routine ($r_s=0.36$, $p<0.001$).

Figure 5.13 illustrates the relationship between a parent's social comparison score and their degree of satisfaction with their child's brushing routine. It shows average satisfaction levels, as measured by a five-point Likert scale, according to whether

parents thought their child's brushing routine was better (social comparison score >0), equal (social comparison score = 0) or worse (social comparison score <0) than that of their peers. Generally, parents who perceived their child's routine to be better than or equal to average had higher levels of satisfaction than those parents who thought their child's routine was worse than average.

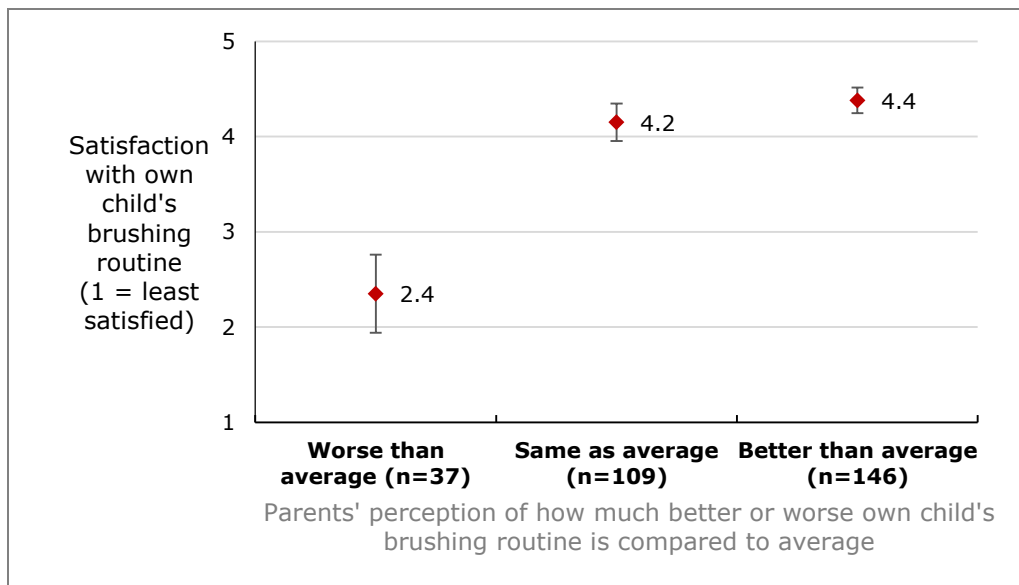


Figure 5.13: Study 2: Parental satisfaction with child's brushing routine according to social comparison score, with 95% confidence intervals

Ordinal regression analysis (Table 5.7) showed that a parent's social comparison score significantly predicted how satisfied they were with their child's brushing routine ($B=0.20$, $p<0.001$), even when controlling for how often a parent reported brushing the child's teeth and other socio-demographic factors. Regardless of the actual brushing frequency, parental satisfaction was significantly associated with the degree to which parents thought their child's routine was better or worse than an average child.

Variable	Regression coefficient	Standard error	Wald	Sig
Parent's 'social comparison' score	0.21	0.04	24.59	<0.001
Child's weekly brushing frequency	0.20	0.05	15.94	<0.001
Child's gender (male v female)	-0.24	0.23	1.07	0.302
Child's age, months	-0.01	0.01	0.47	0.495
No of younger siblings	0.02	0.12	0.01	0.905
No of older siblings	0.28	0.19	2.11	0.146
WIMD deprivation quintile (WIMD = 4-5 vs. WIMD = 1-3)	-0.26	0.25	1.09	0.297

Table 5.7: Study 2: Ordinal regression analysis, predictors of parental satisfaction with child's brushing routine

5.3.6. Toothbrushing motivation, habits and routines

Toothbrushing motivation

Figure 5.14 shows the distribution of parents' motivation for brushing their child's teeth at different times of day, as measured by their choice of different types of fictional toothpastes.

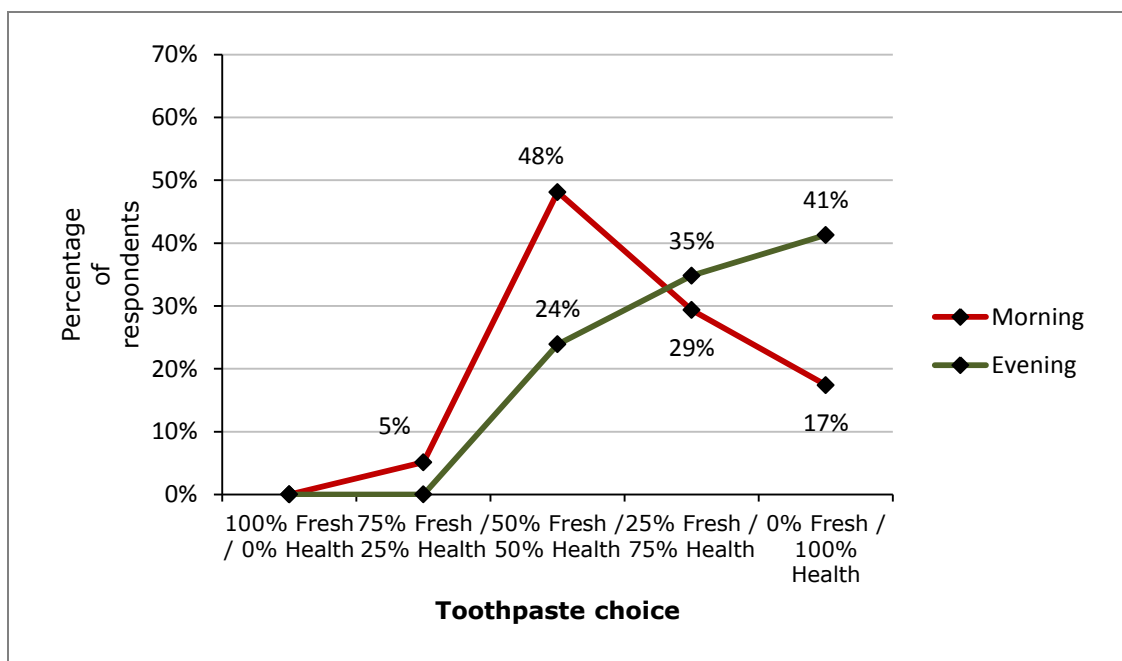


Figure 5.14: Study 2: Distribution of parents' choice of toothpaste for morning and evening brushing

There was a significant difference in toothpaste choices at different times of day, whereby toothpaste choices for morning brushing contained more of the ‘fresh’ ingredient (and so less of the ‘health’ ingredient) compared to toothpaste choices for evening brushing ($Z=9.83$, $p<0.001$).

Toothbrushing habits strength and daily routines

Figure 5.15 shows the distribution of scores on the Self-report Habit Index measure, where possible scores ranged from -20 (weakest possible habit) to +20 (strongest possible habit). They show that the majority of parents reported that brushing their child’s teeth was highly automatic or ‘habitual’, both in the morning and the evening.

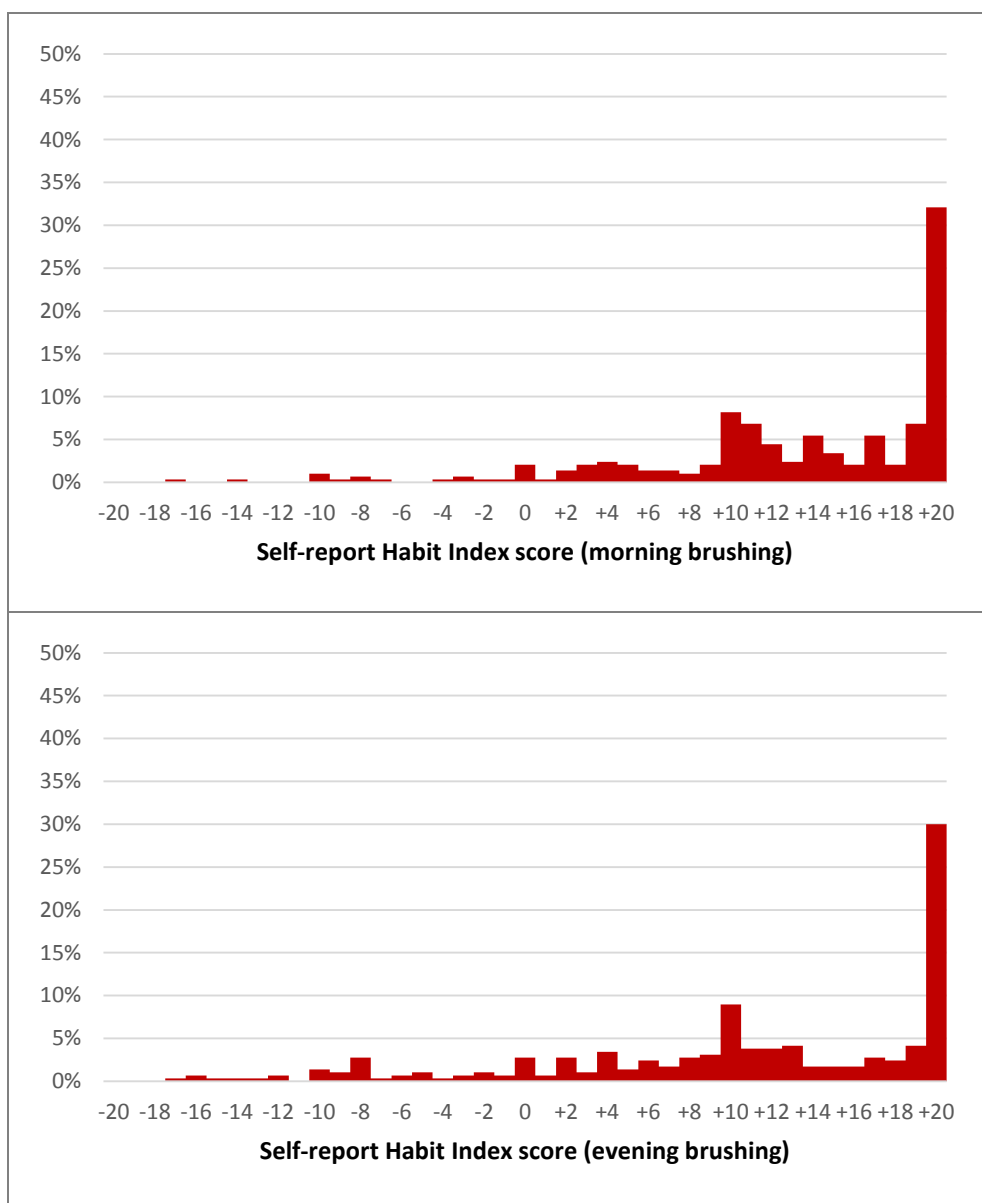


Figure 5.15: Study 2: Distribution of Self-report Habit Index scores, morning and evening brushing

Figure 5.16 shows the distribution of scores on the routine stability measure, where possible scores ranged from -10 (least stable day-to-day routine) to +10 (most stable day-to-day routine).

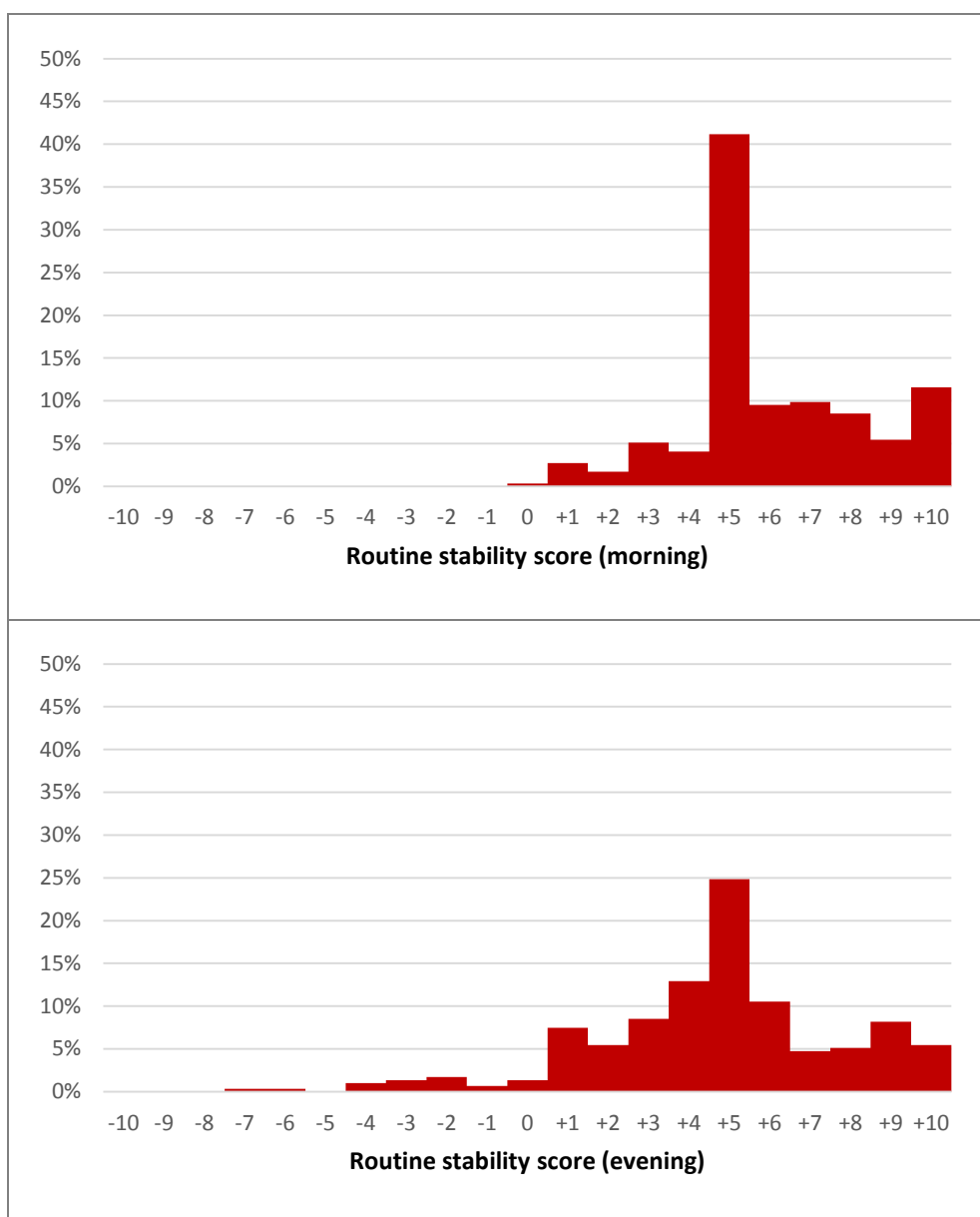


Figure 5.16: Study 2: Distribution of routine stability scores, morning and evening brushing

Bivariate analysis

Table 5.8 and Table 5.9 show a Pearson correlation matrix, showing the relationship between brushing frequency in the morning and evening, and various parental and socio-demographic factors.

Variable	1	2	3	4	5	6	7	8	9
1: Weekly brushing frequency, morning	-								
2: Self-report Habit Index score, morning	0.43**	-							
3: Routine stability score, morning	0.10	0.14*	-						
4: Toothpaste choice (higher = more 'health' ingredient')	0.12	0.15*	0.06	-					
5: Child's age (months)	-0.01	0.06	0.11	0.04	-				
6: No of older siblings	-0.02	0.11	-0.04	0.02	0.02	-			
7: No of younger siblings	0.07	0.04	0.04	-0.04	0.05	-0.13*	-		
8: WIMD quintile (higher = more deprived)	-0.10	0.01	0.03	-0.20**	0.01	0.09	0.02	-	
9: Child's age when parent began brushing (months)	-0.04	-0.05	0.04	-0.12*	-0.01	-0.01	-0.04	0.09	-

Table 5.8: Study 2: Correlation matrix for weekly brushing frequency (morning) (* $p < 0.05$, ** $p < 0.001$)

Variable	1	2	3	4	5	6	7	8	9
1: Weekly brushing frequency, evening	-								
2: Self-report Habit Index score, evening	0.55**	-							
3: Routine stability score, evening	0.19**	0.15*	-						
4: Toothpaste choice (higher = more 'health' ingredient')	0.28**	0.20**	0.01	-					
5: Child's age (months)	-0.06	0.01	0.07	-0.02	-				
6: No of younger siblings	-0.07	0.03	-0.03	-0.03	0.08	-			
7: No of older siblings	0.07	0.05	0.02	0.05	0.05	-0.13*	-		
8: WIMD quintile (higher = more deprived)	-0.20**	-0.09	-0.03	-0.17**	0.01	0.09	0.02	-	
9: Child's age when parent began brushing (months)	-0.10	-0.05	0.07	-0.02	-0.01	-0.01	-0.04	0.09	-

Table 5.9: Study 2: Correlation matrix for weekly brushing frequency (evening) (* $p < 0.05$, ** $p < 0.001$)

Brushing frequency was positively associated with the extent to which parents described brushing their child's teeth as 'habitual' in both the morning ($r_s = 0.43$, $p < 0.001$) and evening ($r_s = 0.55$, $p < 0.001$). There was also a significant positive correlation between the extent to which parents favoured toothpastes with more of the 'health' ingredient and toothbrushing frequency in the evening ($r_s = 0.28$, $p < 0.001$). In the evening, the degree to which a parent described their routine as stable from day-to-

day was positively associated with more frequent weekly brushing ($r_s=0.19$, $p<0.05$), but this relationship did not exist for morning brushing.

Having a more stable day-to-day routine in the morning was significantly associated with a stronger habit for brushing children's teeth in the morning ($r_s=0.14$, $p<0.05$) and the same association existed for evening routines and evening brushing habits ($r_s=0.15$, $p<0.05$).

Figure 5.17 to Figure 5.20 illustrate the relationship between toothpaste choices, SRHI scores and toothbrushing frequency in the morning and evening.

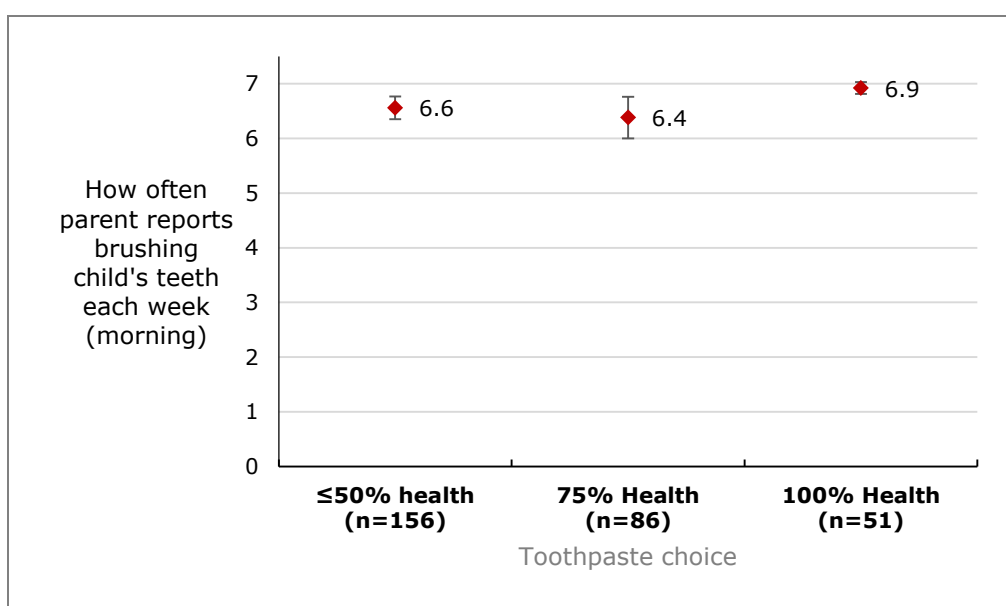


Figure 5.17: Study 2: Weekly brushing frequency according to toothpaste choice (morning) with 95% confidence intervals

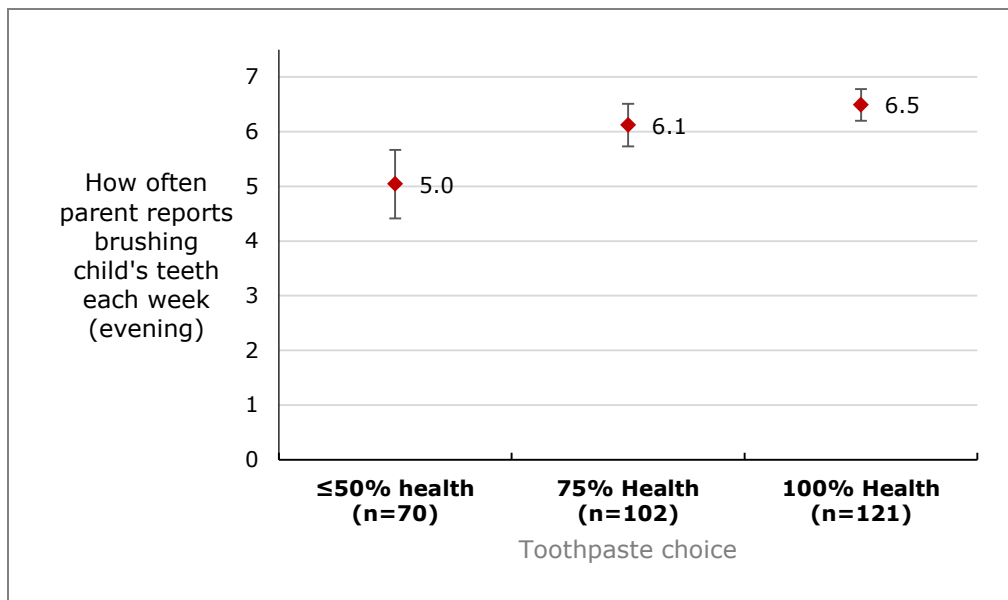


Figure 5.18: Study 2: Weekly brushing frequency according to toothpaste choice (evening) with 95% confidence intervals

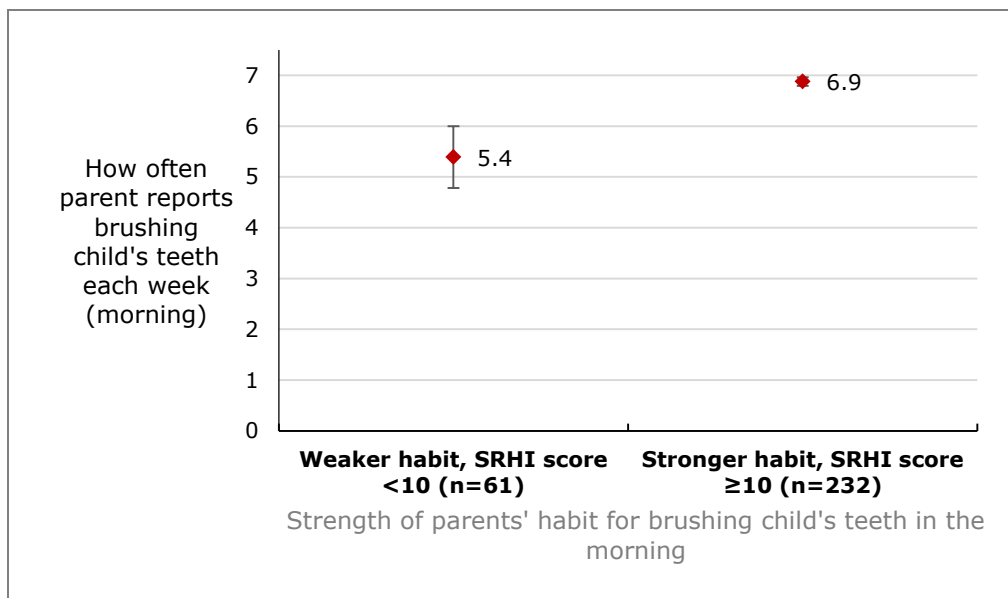


Figure 5.19: Study 2: Weekly brushing frequency (morning) by strength of parental habit for brushing child's teeth, with 95% confidence intervals

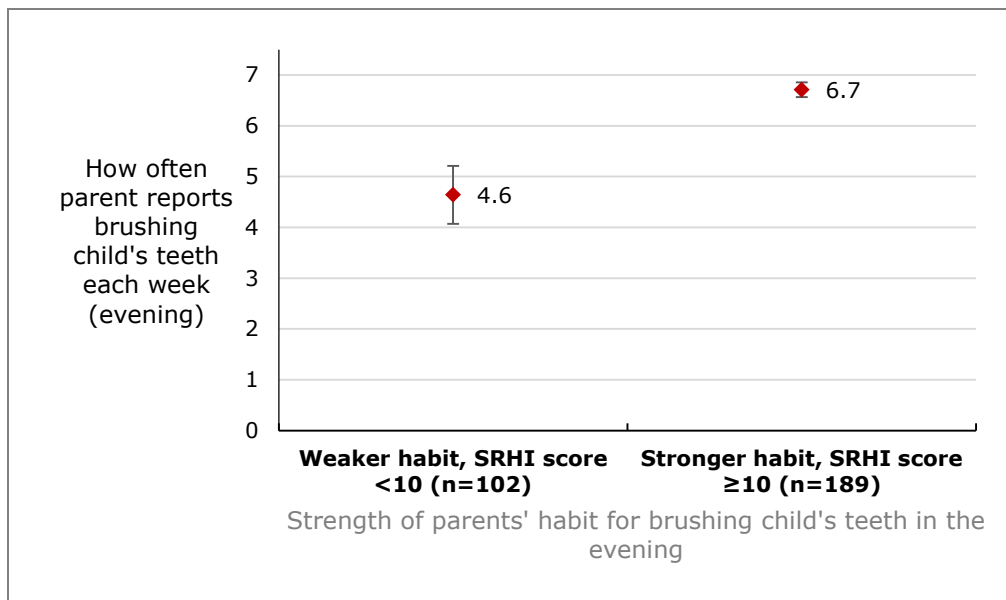


Figure 5.20: Study 2: Weekly brushing frequency (evening) by strength of parental habit for brushing child's teeth, with 95% confidence intervals

Multivariate analysis – predicting missed weekly brushing sessions for morning and evening brushing

Finally, multiple regression analyses were performed to model how often parents missed brushing their child's teeth in the morning (Table 5.10) and evening (Table 5.11).

Variable	Model 1 (Unadjusted)	Model 2 (Adjusted)	Model 3 (Adjusted)
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Strength of parent's habit for brushing child's teeth (per unit increase in SRHI score)	0.82 (0.77-0.87)**	0.81 (0.76-0.87)**	0.79 (0.73-0.86)**
Parents' motivation for brushing child's teeth (per 25% increase in 'health' ingredient)		0.72 (0.41-1.28)	0.82 (0.42-1.57)
Family routine stability (per unit increase in routine stability score)		1.06 (0.89-1.26)	1.07 (0.88-1.29)
Child's age (per month increase)			1.00 (0.98-1.03)
Child's gender			
<i>Female</i>			1.00 (ref)
<i>Male</i>			1.22 (0.45-3.27)
Number of siblings in family (per one sibling increase)			1.11 (0.67-1.83)
Socio-economic status			
<i>WIMD=1-3 (less deprived)</i>			1.00 (ref)
<i>WIMD=4-5 (more deprived)</i>			3.63 (1.15-11.48)*
Child's age when parent started brushing their teeth (per month increase)			0.99 (0.91-1.07)
Parents' perceived cost of toothbrushes/toothpaste			
<i>Not expensive</i>			1.00 (ref)
<i>Fairly expensive/ very expensive</i>			1.51 (0.56-4.07)

Table 5.10: Study 2: Multiple regression analysis, predicting child's weekly brushing frequency (morning)
(*p<0.05, **p<0.001)

Variable	Model 1 (Unadjusted)	Model 2 (Adjusted)	Model 3 (Adjusted)
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Strength of parent's habit for brushing child's teeth (per unit increase in SRHI score)	0.87 (0.84-0.90)**	0.87 (0.84-0.90)**	0.88 (0.85-0.90)**
Parents' motivation for brushing child's teeth (per 25% increase in 'health' ingredient)		0.64 (0.46-0.90)*	0.64 (0.44-0.92)*
Family routine stability (per unit increase in routine stability score)		0.92 (0.84-1.00)	0.92 (0.84-1.01)
Child's age (per month increase)			1.01 (0.99-1.02)
Child's gender			
<i>Female</i>			1.00 (ref)
<i>Male</i>			1.35 (0.77-2.35)
Number of siblings in family (per one sibling increase)			1.02 (0.77-1.36)
Socio-economic status			
<i>WIMD=1-3 (less deprived)</i>			1.00 (ref)
<i>WIMD=4-5 (more deprived)</i>			2.00 (1.07-3.76)*
Child's age when parent started brushing their teeth (per month increase)			1.02 (0.99-1.07)
Parents' perceived cost of toothbrushes/toothpaste			
<i>Not expensive</i>			1.00 (ref)
<i>Fairly expensive/ very expensive</i>			1.10 (0.60-2.03)

Table 5.11: Study 2: Multiple regression analysis, predicting child's weekly brushing frequency (morning)
(*p<0.05, **p<0.001)

When controlling for all other factors in the model, each one unit increase in the Self-Report Habit Index was associated with an expected 21% decrease in the incidence of missed toothbrushing sessions in the morning (IRR=0.79) and a 12% decrease in missed toothbrushing sessions in evening (IRR=0.88). In the evening, toothpaste

choice was significantly associated with brushing frequency, with each 25% increase in the proportion of the 'health' ingredient associated with an expected 37% decrease in missed brushing sessions over the course of a week (IRR=0.63). Parents who lived in areas of higher socio-economic deprivation (WIMD=4-5) were expected to miss brushing their child's teeth significantly more often in the morning (IRR=3.96) and the evening (IRR=2.07) compared to those parents living in areas of less deprivation (WIMD=1-3). At both times of day, no significant interactions were found for missed brushing sessions and demographic factors such as a child's age, gender or number of siblings. Despite being significantly correlated with habit strength, routine stability was not independently associated with brushing frequency in the morning or evening.

5.4. Discussion

5.4.1. Key findings

The current survey found that just over a quarter of parents (28%) of three to six-year old children reported brushing their child's teeth less often than the recommended fourteen times per week. This is broadly consistent with findings from previous, large-scale surveys such as the UK Children's Dental Health Survey (White et al., 2006), in which 17-36% of parents of five year-old children reported brushing their child's teeth less than twice a day, depending on social class.

The main focus of this study, however, was to explore the relationship between a child's weekly toothbrushing frequency and various parental and family factors highlighted as being potentially important in the parent interviews (Chapter 4).

The findings suggest that parental perceptions of 'toothbrushing norms', a parent's motivation for brushing their child's teeth and the extent to which parents find brushing a child's teeth to be automatic or 'habitual' are all associated with the frequency with which children have their teeth brushed at home. The study also looked separately at morning and evening toothbrushing and found differences in brushing frequency and parents' motivation for brushing children's teeth at different times of the day.

Social norms

The results reported here show that parents' perceptions of how often other children had their teeth brushed each week (their 'perceived descriptive norm' for brushing) were significantly associated with how often they brushed their own child's teeth. Previous research in oral health has suggested that adolescents may be motivated to brush their teeth by 'peer pressure' (Stokes et al., 2006), and earlier studies by Blinkhorn showed that mothers of young children looked to friends and dental professionals as a source of information for looking after their child's teeth (Blinkhorn, 1978). However, this was the first study to specifically measure people's perceptions of how often others brush their teeth, and how this relates to their own (or in this case,

their child's) oral health behaviour. Social norms studies have been far more common in the wider health literature, and have consistently demonstrated that people's perceptions of what their peers do are associated with their own behaviour in areas such as alcohol consumption, substance misuse, exercise frequency and food consumption (McAlaney and McMahon, 2007, Lally et al., 2011a). There is also a large body of research showing that people often exhibit a 'better than average' effect, whereby they estimate themselves to be better than an average person in numerous fields (Dunning et al., 2004). This is consistent with the results of the current study which found that most parents imagined that their child's brushing frequency was better or at least equal to that of an average child.

This was also one of the first studies to consider that parents' satisfaction with their child's brushing routine may be affected by more than just the frequency of brushing. The results showed that parents' perceptions of what others do influenced their views about their own child's brushing routine. This apparent influence of 'social comparison' echoes findings from economic studies, where researchers have found that people's satisfaction with their salary depends on how they think it compares with that of their colleagues or peers rather than its absolute value (Brown et al., 2008). In health, people's perceptions of risk or vulnerability to disease also appear to be moderated by comparing themselves with others (Klein, 1997).

Toothbrushing motivation

The results of the study showed that there were individual differences between parents in terms of their motivation to brush their child's teeth. There was also a general pattern whereby parents had a more short-term focus for brushing their child's teeth in the morning compared to brushing in the evening.

Previous qualitative research has pointed to the fact that children and adolescents often focus on more cosmetic aspects of toothbrushing such as brushing their teeth to achieve 'fresh breath'. Gill and colleagues, for instance, interviewed 6-7 and 10-11 year old children and reported that children's rationalisations for brushing were often related

to “personal grooming and cleanliness rather than caries prevention” (Gill et al., 2011). To date, however, there has been little research looking at parents’ motivation for brushing their young children’s teeth. The use of a ‘toothpaste choice’ vignette allowed for a quantitative measure of toothbrushing motivation, whereas most previous research considering motivation for oral hygiene has been conducted via qualitative research methods such as interviews or focus groups. This approach to measuring motivation also showed that parents may be motivated to brush their child’s teeth for different reasons at different times of day, a finding which has received little attention in the literature to date.

Routines and habits

The results of the study showed that parents who reported that brushing their child’s teeth was more automatic or ‘habitual’ reported more frequent brushing over the course of a typical week. There was also a moderate but significant relationship between the extent to which parents reported that brushing was habitual and the stability of the family’s day-to-day routines and daily activities in the household.

Some researchers have acknowledged the fact that people’s daily lives or “schedules” are likely to influence daily oral health habits such as toothbrushing (Croucher, 1994, Aunger, 2007). Aunger, for instance, describes toothbrushing as being “commonly performed in a regularised, automatic (i.e., routine) manner” (Aunger, 2007). Despite this, there has been a lack of research exploring the way in which day-to-day routines might impact on parents’ decisions or ability to implement regular toothbrushing regimes for their young children. Some studies have looked at proxy measures for home routines, in relation to toothbrushing. Levin and Currie, for instance, used data from the 2006 Health Behaviour in School-Aged Children Survey to show that adolescents who frequently went to bed without an evening meal were less likely to brush their teeth twice a day, even when controlling for socio-economic status (Levin and Currie, 2010).

To date, this is the first attempt to measure 'habit' in relation to toothbrushing and specifically toothbrushing frequency. The validated Self-report Habit Index appeared to be a suitable tool for using in this population. The concept of habituation has been increasingly applied to the analysis of wider health-related behaviours such as exercise and diet. Consistent with the findings reported here, several cross-sectional and prospective studies using measures of habit such as the SRHI indicate that health behaviours which become habitual are carried out more consistently over time (Verhoeven et al., 2012, Gardner et al., 2012, Allom et al., 2013).

Morning / evening brushing

The findings showed that parents were significantly more likely to brush their child's teeth in the morning compared to the evening. Very few studies have looked at weekly toothbrushing frequency, rather than using a measure of daily brushing which compares categories of brushing frequency such as 'twice a day' or 'once a day or less'. In Sweden, researchers reported that morning brushing was significantly more common than evening brushing among a cohort of 162 teenage girls who were followed over a three-year timespan (Bruno-Ambrosius et al., 2005). Similarly, MacGregor and colleagues reported data from a large survey of 14-15 year old children in the UK, which showed that most brushed in the morning (75%) but very few brushed in the evening (23%). They found that those who brushed less often were "motivated more by social reasons than by preventive dental health factors" (Macgregor et al., 1996).

Socio-demographic factors

Previous studies have reported mixed results regarding the association between family size and oral health outcomes in children (Hooley et al., 2012b). The current study found no significant relationship between the number of siblings a child had and the frequency with which parents brushed their teeth. Socio-economic status was used primarily as a control variable in the current study, and the sample was deliberately skewed towards those from more deprived areas. Even within this skewed sample,

however, there was an association between higher levels of deprivation and less frequent brushing which mirrors previous findings in the literature (Pine et al., 2004a, White et al., 2006).

5.4.2. Methodological considerations

Self-complete surveys and potential sources of error

In comparison to face-to-face interviews and telephone interviews, self-complete surveys involve a greater risk of the participant misunderstanding questions (measurement error), answering questions incorrectly (response error), missing certain questions accidentally or through choice (item non-response), or deciding not to complete the survey at all (non-response error) (Bryman, 2012). As a result, careful consideration was given to the design, layout and length of the survey, and the wording of instructions and questions. Table 5.12 summarises some of the principles incorporated in to the design and wording of the questionnaire:

Potential source of error	Steps taken to reduce risk of error
Measurement error	<ul style="list-style-type: none"> • Formatting survey to ensure that question numbers, questions and answers were easily distinguishable • Ensuring that questions were worded carefully, in order to be as short as possible while being easily understood by the study participants • Avoiding asking more than one question at a time
Response error	<ul style="list-style-type: none"> • Adding clear completion instructions for each question (e.g., “tick one box only”, “tick one box per row”) • Wherever possible, avoiding questions which required any arithmetic or calculation on behalf of the participant
Item non-response error	<ul style="list-style-type: none"> • Adding clear routing instructions, where questions could be skipped depending on preceding answers • Ensuring that similar questions were grouped together wherever possible
Non-response error	<ul style="list-style-type: none"> • Ensuring that the survey looked professional, through the use of official logos, and consistent fonts and font sizes • Ensuring that the survey was kept as short as possible (six A4 pages) • Ensuring that the first group of questions were easy to answer and applied to all participants • Placing potentially difficult questions towards the end of the survey

Table 5.12: Study 2: Potential sources of error in survey design and steps taken to avoid them

A covering letter was designed to accompany the questionnaire, utilising a number of the recommendations advocated by Dillman’s widely cited ‘Total Design Method’: personalising the correspondence by including the participant’s name (derived from the consent forms), emphasising the importance of the research and giving clear instructions on how to return the questionnaire (Dillman, 2007).

5.4.3. Data quality and limitations

A number of steps were taken throughout the design and administration of the survey to ensure data quality and rigour. However, it is important to acknowledge some limitations and potential sources of bias in the results of the study. The following section considers the reliability, validity and generalisability of the data, and the extent to which any limitations may affect the interpretation of the findings.

Reliability

One important aspect to ensuring reliability in questionnaire surveys is that participants understand and correctly interpret the questions being asked. In the current study, the questionnaire was piloted extensively before being finalised. In particular, the 'think aloud' testing allowed the researcher to check participants' understanding of each question, and ensure that question and answer wording were clear and unambiguous.

Internal consistency was measured for all multi-item measures, such as the Self-report Habit Index and the measure of routine stability. Cronbach's alpha is a test to examine the relationships between the various items of the scale, to ensure that they are all measuring a single trait. All correlation coefficients were high, suggesting that the measures showed good internal reliability. For the single-item outcome measure of weekly toothbrushing frequency, a form of triangulation was used whereby brushing frequency was measured using multiple questions: parents were asked about how often they brushed their child's teeth each week; how often they brushed their child's teeth each week in the morning; and how often they brushed their child's teeth each week in the evening. The summed scores of morning and evening brushing frequency were compared to the answers for overall weekly brushing frequency, showing excellent reliability.

One method of assessing the consistency of questionnaire measures over time is the test-retest method. This involves administering the measure to the same participants at two different intervals and assessing the correlation between the two sets of responses, and can be used for both single and multi-item measures (Bryman, 2012). This was not deemed practical in the current study, given the time limitations of the overall PhD project and the resources expended on achieving the response rate for the original survey. Future research may wish to explore the extent to which factors such as parents' motivation for brushing their children's teeth and their perception of toothbrushing norms remain stable over time.

Validity

The validity of a questionnaire measure refers to the extent to which it actually measures the concepts that is supposed to (de Vaus, 2002).

One form of validity is 'face validity' (Bryman, 2012). Face validity refers to the extent to which a measure *appears* to reflect the concept in question. In the current study, face validity was established through rigorous piloting of the questionnaire with parents who were similar to those used in the final sampling frame. The questionnaire was also reviewed and approved by staff from the Community Dental Service, who work closely with parents from the study population, and a consultant in Dental Public Health who was supervising the PhD project.

Wherever possible, concepts in the current study were assessed using previously validated measures. Habit strength, for instance, was assessed using the validated Self-report Habit Index (Verplanken and Orbell, 2003), as the questions were felt to adequately reflect the sort of habits that parents had discussed in the interviews. In some cases, however, it was necessary to develop new questions and measures which had not previously been tested. This was done because existing measures were felt to inadequately measure a particular concept in relation to oral health, or because the measure was unsuitable for use in a short questionnaire survey. With routine stability, for instance, consideration was given to using a number of validated assessment instruments, such as the Family Routines Inventory (Jensen et al., 1983) or the associated Child Routines Inventory (Sytsma et al., 2001). However, both of these measures were felt to be too arduous to be included in a larger questionnaire survey, and they are intended to measure broader aspects of daily routines and 'rituals' which were not directly relevant for the current study. In other cases, such as with toothbrushing motivation, there had been no previous attempt to measure the concept quantitatively and so no existing measures were available to use.

One of the benefits of using an exploratory mixed-methods approach, where quantitative work follows on from qualitative research, is that the qualitative data can be

used to help develop appropriate questions and measures for a survey. The multi-item tool employed to measure routines was therefore grounded in the data from the parent interviews. Items such as 'having breakfast' and 'having a wash' were included because they were specific events that parents had referred to in the interviews as typically occurring before or after toothbrushing. The measure showed good internal reliability, but further testing is needed to establish its validity. Likewise, the vignette developed to measure a parent's motivation for brushing their child's teeth would benefit from being tested on wider populations.

It is important to acknowledge that the reliance on self-reported data for measuring toothbrushing frequency may reduce the validity of the findings: parents may exhibit a social desirability bias and exaggerate their own child's brushing frequency. This is a limitation of any research relying on self-reported or recalled data. Future research may seek to use objective oral health measures, but this typically involves a greater cost and investment of time. It should be noted, however, that numerous cross-sectional studies have found significant associations between parent-reported brushing frequencies for their children and objective measures of the child's oral health (Pine et al., 2004a, Steckslen-Blicks et al., 2004, Peres et al., 2005). These studies suggest that parental reports of their child's oral hygiene behaviour can be considered to have reasonable validity.

Generalisability

The sampling frame for this study was deliberately focused on parents from areas of high socio-economic deprivation, due to higher levels of dental caries among children reported in these populations, and so was fairly homogenous in terms of socio-economic status. The sample was also drawn from a relatively small geographic area. These factors limit the extent to which the findings reported here can be generalised to wider populations. Further research is needed to see if the concepts explored in the study may be relevant to other populations of parents and children. It would be

interesting to see the extent to which parents from different socio-economic backgrounds were motivated to brush their child's teeth by similar or disparate factors.

The process of recruiting parents for the current study was affected by adherence to data protection laws, which meant that schools were not able to provide contact details of all parents in their classroom. This necessitated the two-stage process of obtaining consent from parents to be contacted, and then sending questionnaire surveys directly to those who agreed to take part. An alternative approach would have been to give questionnaire surveys to parents directly, but this would have eliminated the ability to follow-up non-respondents.

Every effort was made to maximise the response rate, both in the design and administration of the survey. A systematic review explored techniques which have been shown to improve postal survey response rates in randomised control trials (Edwards et al., 2002): The current study employed the vast majority of these approaches, including:

- Ensuring that the questionnaire was relatively short
- Providing a stamped and pre-addressed return envelope
- Personalising envelopes, questionnaires and covering letters
- Using coloured ink
- Sending the questionnaire using a first class stamp
- Following up non-responders with telephone calls
- Sending replacement questionnaires to non-responders
- Sending the questionnaire from a University rather than a private company

Despite these efforts, the response rate of 48% means that the data is likely to be affected by some degree of non-respondent bias. Although there was no significant difference in socio-economic status between respondents and those who provided consent forms but did not respond, it is not possible to account for the parents who did not return a consent form at all. It might be expected, for instance, that these parents would brush their children's teeth less often than those who did respond. While this

source of bias may affect estimates of how many parents brush their child's teeth twice a day or fourteen times a week, for instance, the primary aim of this study was to explore the relationship between brushing frequency and the other independent variables being studied.

Other considerations

While the current study focused on toothbrushing frequency as an outcome measure, it must be acknowledged that frequency of brushing is only one component of oral hygiene. Whereas there are clear, evidence-based guidelines for brushing frequency based on findings from clinical trials, there is currently less consensus as to best practice with other aspects of brushing such as technique and brushing duration. These aspects of oral hygiene are also much more difficult to measure in a questionnaire survey.

Parents were not asked about whether they used fluoride toothpaste when brushing their child's teeth. It was felt that parents would be unlikely to know whether or not their child's toothpaste contained fluoride. Moreover, recent data show that almost all of the widely available toothpastes sold in the UK contain fluoride as their main active ingredient (UK Medicines Information, 2012), suggesting that the vast majority of parents surveyed will have been using fluoridated toothpaste with their child.

Due to high levels of item non-response, it was unfortunately necessary to exclude from the analysis one group of questions on 'delay discounting' – a concept which measures the extent to which a person favours more immediate rewards, compared to rewards occurring in the future. Although parents in the pilot study also struggled to answer these questions, it was hoped that subsequent amendments to the question wording would lead to more parents answering the question in the main survey. Parents were asked to give a monetary value at which they would sell a hypothetical lottery ticket, but the absence of a 'would not sell' answer option meant that where participants left the answer blank, it was unclear whether they were indicating that they would not sell the ticket or whether they had simply skipped the question. This was to

some extent an error in question wording, but it is also likely to be the case that some questions or measures which to date have been tested primarily on University or college students may not successfully transfer to wider populations without significant modification. Future research may be needed to adapt such measures for use in lay populations.

Following observations from ‘think aloud’ pilot testing, a decision was made to remove from the survey certain demographic questions relating to parents’ age, gender and education level. It was anticipated that it would be challenging to achieve an acceptable response rate to the survey, due to the population being sampled, and the pilot testing suggested that the inclusion of these questions may negatively impact response rates. The removal of these questions was therefore a pragmatic decision rather than a deliberate omission. As with family size, there have been mixed findings reported as to the influence of parental age and children’s oral health outcomes (Hooley et al., 2012b). However, it would have been useful to control for a parents’ age in the multivariate analysis, and to explore the extent to which age was related to variables such as parents’ perceived norms for toothbrushing. In the case of education level, it was felt that socio-economic status derived from an area-based measure of deprivation would be a sufficient proxy. Future studies may seek to explore the influence of parental age and gender on the various independent variables studied here.

Finally, as with any cross-sectional survey, significant associations between variables do not give any information about the direction of causality: it may be, for instance, that parents’ estimate of how often other children have their teeth brushed are influenced by how often they brush their own child’s teeth, rather than vice versa.

5.4.4. Conclusions

This study set out to measure some of the concepts developed from Study 1 (Chapter 4), and explore the extent to which these factors were related to how often parents reported brushing their child’s teeth at home. The results show that a number of

parental factors are associated with a child's brushing frequency, including: a parents' estimate of how often other parents brush their children's teeth; the extent to which brushing is automatic or 'habitual'; and the extent to which a parent views brushing their child's teeth as having primarily short-term or long-term benefits. They also show that parents were more short-term oriented when considering the benefits of morning brushing compared to evening brushing, and reported brushing their child's teeth more often in the morning than the evening.

5.5. Chapter summary

The current chapter reported on findings from a questionnaire survey completed by 297 parents of children aged 3-6 years old, from socio-economically deprived areas of South East Wales. The questionnaire measured when and how often parents brushed their child's teeth at home, and looked at factors such as toothbrushing motivation, perceived norms, and habit formation which were highlighted as being important in the previous qualitative study.

A number of the findings are novel to oral health, including:

- The idea that parents' perceptions of how often other children have their teeth brushed are associated with how often they report brushing their own child's teeth
- The idea that parents' satisfaction with their child's brushing frequency was affected by their perception of how it compared with other children
- The idea that parents brushed their children's teeth more often in the morning than the evening, and often had different reasons for brushing children's teeth at different times of day
- The idea that parents who reported brushing their child's teeth was more automatic or habitual carried out more regular toothbrushing over the course of a typical week

These findings were considered in relation to the existing literature, and consideration was given to the study's limitations.

The findings relating to parents' perceived social norms for brushing frequency, and the influence of social comparisons formed the basis of the final study described in the following chapter.

6. STUDY 3 – EXPERIMENTAL STUDY

This chapter describes the third and final study of the PhD project, an experimental study in which a pen and paper test was administered to 121 parents of children aged 3-6 years old, resident in areas of high socioeconomic deprivation in South-East Wales.

The study built on the work carried out in the parent interviews and parent surveys described in Study 1 (Chapter 4) and Study 2 (Chapter 5). The findings from these studies suggested that parents' decisions about how often to brush their child's teeth were associated with what they believed other parents did (perceived social norms), and that their satisfaction with their child's brushing routine depended on how much better or worse they thought it was compared to other children (social comparison). In this study, parents were presented with information about how often other parents brushed their children's teeth each week, and asked to rate how healthy they thought each brushing routine was. Afterwards, they were asked how healthy they thought their own child's brushing routine was. By presenting different information to different groups of parents, it was possible to explore in more depth the way in which parents' judgements about toothbrushing are influenced by comparisons with their peers.

The *introduction* (Section 6.1) gives some background to 'Range Frequency Theory' which provided a theoretical framework for the study, and outlines the aims and objectives of the study. The *methods* section (Section 6.2) describes how the study was developed and administered and describes the study population. The *results* section (Section 6.3) presents details of the survey participants, and presents the main findings from the study, addressing each of the study objectives in turn. Finally, the *discussion* section (Section 6.4) reflects on the key findings of the study and how they compare to and add to the existing literature. The *discussion* section also considers the limitations of the study, and reflects on the methodology.

6.1. Introduction

6.1.1. Background

The interviews conducted in Study 1 (Chapter 4) explored factors which influenced parents' decisions about how often to brush their child's teeth at home. One of the findings that emerged was that parents often justified their decisions by referring to what they thought other people might do. This idea was further explored in Study 2 (Chapter 5), where parents were asked to estimate how often they thought an 'average' child might have their teeth brushed at home, and asked how satisfied they were with their own child's brushing routine. The results showed that parents generally tended to be satisfied with their child's brushing routine as long as they thought it was similar to or better than the 'average' child – regardless of how often their child actually brushed each week.

Taken together, these findings suggest that parents' decisions about what might be a healthy number of times to brush their child's teeth might not be absolute – that is, they may not simply judge their child's brushing routine against a fixed benchmark, such as the recommendation to brush children's teeth twice a day. Instead, parents' decisions about how often to brush their child's teeth appear to be relative, and influenced by a process of social comparison.

Range-Frequency Theory

One theory which offers a framework for understanding how people's judgements can be affected by contextual factors is Range-Frequency Theory (Parducci, 1965). The theory was developed and tested via a series of psychophysical experiments, assessing the way in which people made judgements about, for instance, the relative size of numbers or squares (Birnbaum et al., 1974); the sweetness of soft drinks, the loudness of sounds (Birnbaum et al., 1971), or the length of objects (Parducci and Marshall, 1961).

Over this series of experiments, researchers observed that what people classified as a 'loud' sound, a 'large' shape or a 'heavy' weight was highly influenced by the frame of reference or 'contextual set': it depended on the other shapes, sounds or weights presented at the same time. People would tend to describe a shape as being large when it was shown next to mostly smaller shapes, but the same size shape was described as small when shown with relatively larger shapes. This pattern of results was shown for judgements about the weight of items, the size of shapes, the brightness of colours and the sweetness of drinks.

The work identified two specific principles which tended to predict people's relative judgements. The first principle was called the 'rank principle'. In terms of shape size, for instance, shapes would typically be categorised as being larger when they were one of the largest shapes among all the shapes being presented (i.e., they ranked relatively high among all other shapes). The second principle was called the 'range principle'. Here, they found that shapes would be categorised as larger when they were relatively close in size to the largest shape being presented (i.e., they were close to the top of the range).

More recently, researchers have shown that the rank and range principles of Range-Frequency Theory can be applied to understanding people's judgements in broader economic, social and health-related fields. The theory has been shown to accurately model people's judgements of their own personal happiness (Boyce et al., 2010a), their satisfaction with their job salary (Brown et al., 2008), their perceptions of body image (Wedell et al., 2005), and the extent to which they express gratitude for different amounts of help from other people (Wood et al., 2011).

Maltby and colleagues, for instance, conducted an experimental study where they asked participants to rate various amounts of weekly exercise (e.g., 15 minutes, 30 minutes, 60 minutes) in terms of their potential benefit to health (Maltby et al., 2012). The results clearly demonstrated the rank principle of Range Frequency Theory. Rather than there being any consensus about how healthy, for instance, 90 minutes of

exercise was, they found that one group of participants rated 90 minutes as being more healthy when it was presented with mostly lower values, but another group rated it as less healthy when it was presented with mostly higher values.

Figure 6.1 illustrates the two principles of Range Frequency Theory as applied to a hypothetical example of people's satisfaction with their salary. In the first example (*rank principle*), Person B would be predicted to be happier with their salary than Person A, because even though the absolute values of their salary are the same, Person B perceives themselves to rank higher among their colleagues or friends. In the second example (*range principle*), Person A would be predicted to be happier with their salary than Person B, because even though the absolute value is the same and they both perceive themselves to rank the same among their colleagues or friends, Person A believes their salary to be closer to be nearer the maximum possible salary.

<i>Rank principle</i>		<i>Range principle</i>	
<i>Person A</i>	<i>Person B</i>	<i>Person A</i>	<i>Person B</i>
£50,000			£80,000
£40,000			
£35,000	£50,000	£40,000	
[4 th] £30,000	£30,000 [2 nd]	£30,000	£30,000
£20,000	£27,500	£27,500	£27,500
	£25,000	£25,000	£25,000
	£20,000	£20,000	£20,000

Figure 6.1: Study 3: Illustration of the rank and range principles of Range-Frequency Theory, using the example of annual salary

Parents' views on morning and evening brushing

The interviews conducted with parents in Study 1 (Chapter 4) found that parents tended to talk about brushing their child's teeth in the morning and in the evening as separate events. Study 2 (Chapter 5) developed this idea, by showing that parents tended to be motivated to brush their child's teeth for different reasons in the morning and evening, with more of a focus on cosmetic factors in the morning. Moreover, it was

found that parents tended to brush their child's teeth more often in the morning than they did in the evening. These findings raise the question of whether parents perceive brushing their child's teeth in the morning to be important for their oral health than brushing in the evening.

6.1.2. Research aims and objectives

Aims

- (1) To explore the extent to which parents' judgements about oral health are affected by contextual information
- (2) To establish whether parents see morning brushing as being more important for a child's oral health than evening brushing

Objectives

- (1) To manipulate information shown to parents about how often other parents brush their child's teeth each week, in order to test whether their judgements about what constitutes a healthy or unhealthy brushing routine conform to the *rank principle* of Range-Frequency Theory
- (2) To manipulate information shown to parents about how often other parents brush their child's teeth each week, in order to test whether their judgements about what constitutes a healthy or unhealthy brushing routine conform to the *range principle* of Range-Frequency Theory
- (3) To manipulate information shown to parents about how often other parents brush their child's teeth each week, in order to test whether this has any subsequent effect on their perceived norm for weekly brushing among other parents
- (4) To manipulate information shown to parents about how often other parents brush their child's teeth each week, in order to test whether this has any subsequent effect on how satisfied they are with their own child's brushing routine

(5) To ask parents to rate the healthiness of various weekly brushing frequencies – some in which brushing is primarily done in the morning, some in which brushing is primarily done in the evening – in order to test whether parents rate morning brushing as being more healthy than evening brushing.

6.2. Methods

6.2.1. Study population

Participants were 121 parents or caregivers of children aged between 3-6 years old. The children were attending one of twelve nursery and infant schools that were participating in the Designed to Smile toothbrushing scheme in the Cardiff and Vale University Health Board area, South-East Wales. The Designed to Smile toothbrushing scheme is a targeted programme delivered in schools in areas of high socio-economic deprivation. As each of the schools enrolls pupils from surrounding 'catchment areas', parents whose children attend the schools are typically resident in areas with similar socio-economic characteristics.

Twelve nursery schools and primary schools were randomly selected from the full list of 163 nursery schools and schools taking part in the Designed to Smile scheme in the Cardiff and Vale University Health Board.

Before recruitment started, letters were sent to headteachers of each of the schools, informing them of the nature of the study and the recruitment process and giving them the opportunity to ask questions or withdraw their school's support.

At each school, eligible parents of children attending nursery (up to 3 years old), reception (4-5 years old) and Year 1 (5-6 years old) classes were invited to take part in the study. Recruitment was aided by staff from the Community Dental Service who distributed invitation letters, information sheets and consent forms to class teachers to circulate to parents.

Each parent received a covering letter and an information sheet (Appendix 6) explaining the nature of the study, and were encouraged to contact the researcher if they had any further questions. Parents were told to complete an attached consent form (Appendix 6), giving their name and contact details, if they wished to take part in the study. They returned consent forms to the classroom teacher in a sealed envelope,

and these forms were then collected by CDS staff who returned them to the researcher (Figure 6.2).

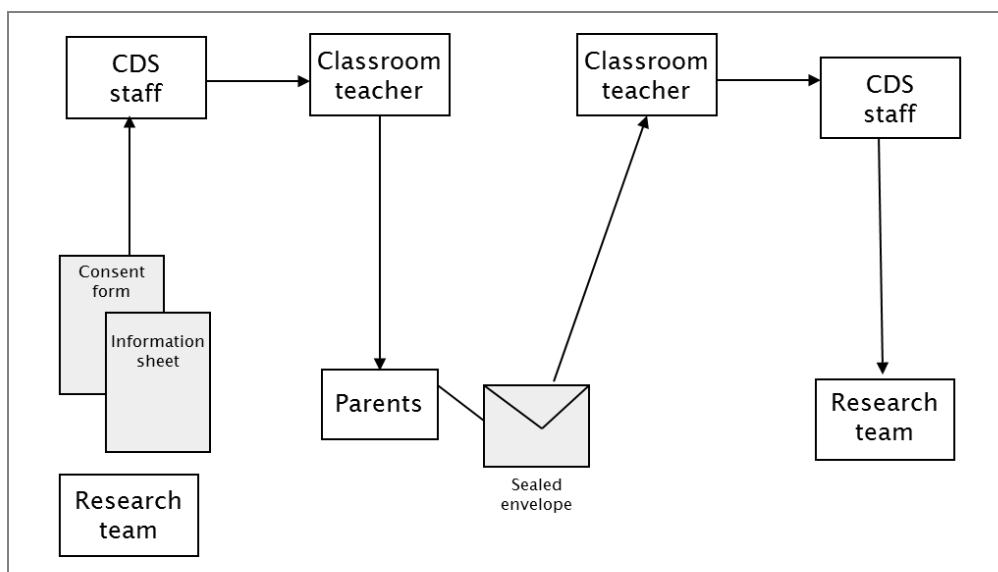


Figure 6.2: Study 3: Summary of the recruitment process

Consenting parents were contacted by telephone, where they had the chance to ask questions about the study, and were then asked to confirm that they still wished to take part in the study. If parents consented, a convenient time and place was agreed upon for them to complete the exercise while the researcher was present. Parents who had signed a consent form were called a maximum of three times (at least once in the evening or at the weekend) and where possible, an answerphone message was left giving the researcher's contact details and asking parents to call back if they still wished to take part in the study. After an unsuccessful third contact attempt, parents were not contacted any further.

6.2.2. Study design and procedure

The research design was adapted from a series of experimental studies carried out by Wood and colleagues (Wood et al., 2011, Wood et al., 2012a, Wood et al., 2012b), in which they tested whether people's judgements about alcohol consumption, exercise duration and gratitude adhered to the rank and range principles of Range Frequency Theory (Parducci, 1965).

Parents were initially allocated to one of four experimental groups. Group allocation was conducted sequentially, whereby the first participant to carry out the exercise was assigned to be in Group 1, the second participant in Group 2 and so on.

Participants completed a pen and paper exercise in their home or in a quiet location such as a cafe or their place of work. The researcher introduced the study as being related to their child's toothbrushing routine, and encouraged them to be as honest as possible with their answers, assuring them that all results would be anonymised and stored confidentially.

Before the exercise, participants were given the same standardised instructions (Figure 6.3). Participants were then presented with the 6-page exercise sheet (Appendix 8), and told to follow the instructions on each page and to take as much time as they needed. They were told to complete the exercise in relation to the child that was named on the consent form. The researcher was present at all times during the exercise, and parents were encouraged to ask questions if there was anything they were unsure of. Otherwise, participants were left to complete the form on their own. The exercise typically took around 15-20 minutes to complete.

Thank you for agreeing to take part in the study.

I'm going to give you a six-page booklet containing a few simple exercises, relating to how often you and some other parents brush their children's teeth at home. We'll show you how often some other parents who've taken part in previous surveys have told us they brush their child's teeth each week, and ask you to say how healthy or unhealthy you think those children's brushing routines are.

Please complete the exercises in the order they are shown in the booklet. Each of the pages contain instructions which explain how to complete the exercise, so please take as long as you need to read and complete each page. If you need help understanding

how to complete any of the pages, then please feel free to ask me.

*There are no right or wrong answers – we are simply interested in your opinion.
Remember that any information you provide will be completely anonymous, so please
be as honest as possible with your answers.*

Figure 6.3: Study 3: Introductory text read to each participant, prior to the exercise

In all groups, parents were first asked for their child's age and gender, and then to indicate how often they brushed their child's teeth at home each week. Parents were subsequently presented with a table showing how many times nine other parents brushed their child's teeth in a normal week, and told that the data was taken from a previous survey of toothbrushing habits. On the following page, they were then asked to rate each of the nine brushing routines on an 11-point scale, ranging from 1 (very unhealthy) to 11 (very healthy).

In two subsequent exercises, parents were shown the same list of parents and brushing frequencies again, but in addition to the weekly brushing frequency, they were shown how often each parent brushed their child's teeth in the morning, and how often they brushed their child's teeth in evening. For instance, a parent who was shown to have brushed their child's teeth 10 times a week might be shown to have brushed the child's teeth 7 times in the morning and 3 times in the evening. Again, parents were asked to rate each routine on the 11-point scale ranging from 1 (very unhealthy) to 11 (very healthy).

On the final page, parents were asked to use the same 1-11 scale to indicate how healthy they believed their own child's brushing routine was. They were then asked to estimate how often they thought an 'average' child in their son or daughter's school class might have their teeth brushed at home each week.

Figure 6.4 summarises the study flow.

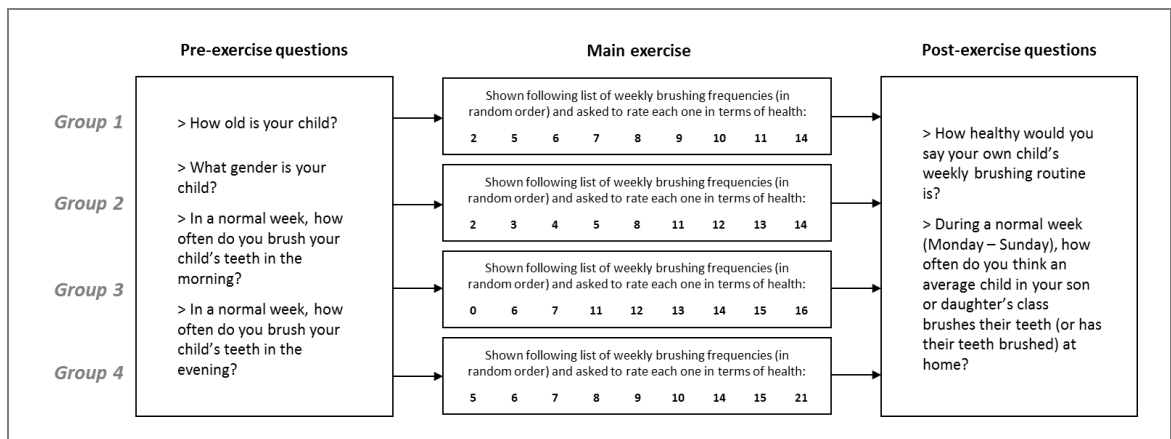


Figure 6.4: Study 3: Summary of the study flow

Experimental manipulation

The main experimental manipulation was the set of nine brushing frequencies that each participant saw. Participants were shown one of four different sets of numbers, depending on their group allocation. In Groups 1 and 2, the distribution of brushing frequencies was manipulated to test the 'rank principle' of Range Frequency Theory, whereas in Groups 3 and 4, the distributions were manipulated to test the 'range principle'.

Testing the rank principle

Table 6.1 shows the distribution of the brushing frequencies presented to participants in Group 1 and Group 2. Participants were told that the numbers represented the frequency with which various parents had reported brushing their child's teeth in a normal week, and were shown the brushing frequencies in a randomised order. The frequencies common to each group are highlighted in red for the purpose of illustration. All frequencies were presented to the participants in black text.

Group 1	Group 2
<i>Weekly brushing frequency</i>	<i>Weekly brushing frequency</i>
2	2
5	3
6	4
7	5
8	8
9	11
10	12
11	13
14	14

Table 6.1: Study 3: Brushing frequencies presented to participants in Group 1 and Group 2

The range (12) and sum of brushing frequencies (72) was equal for both groups: that is, the difference between the maximum value (14) and minimum value (2) were the same, and the nine brushing frequencies added to the same value for both groups. The highlighted values (5, 8 and 11 times per week) were common to both groups and were used as reference points. The three reference points were of equal proximity to the minimum, maximum and mean values in each group.

The only way in which the reference points differed between groups was in their rank position among the other brushing frequencies. In Group 1, “5 times per week” was the second lowest value in the group (rank = 8th out of 9), whereas in Group 2, it was the fourth lowest value (rank = 6). “11 times per week” was the second highest value in Group 1 (rank = 2), whereas it was the fourth highest in Group 2 (rank = 4). In both groups, “8 times per week” was ranked in the middle of the group (rank = 5).

This allowed for a direct test of the rank principle: because their proximity to the range and distance from the mean was the same, any difference in the way that the two groups rated the “5 times per week” and “11 times per week” frequencies could only be accounted for by the fact that these values differed in their rank position.

Testing the range principle

Table 6.2 shows the distribution of the brushing frequencies presented to participants in Group 3 and Group 4. Again, participants were told that these numbers represented the frequency with which various parents had reported brushing their child's teeth each week, and the order of brushing frequencies was randomly generated for each participant.

Group 3	Group 4
<i>Weekly brushing frequency</i>	<i>Weekly brushing frequency</i>
0	5
6	6
7	7
11	8
12	9
13	10
14	14
15	15
16	21

Table 6.2: Study 3: Brushing frequencies presented to participants in Group 3 and Group 4

Despite the different distributions, the range (16) and sum of brushing frequencies was equal for both groups (95).

The only difference between the groups was that in Group 3, the majority of the values were close to the top of the range (i.e., the distribution was negatively skewed), whereas in Group 4, the majority of the values were closer to the bottom of the range (the distribution was positively skewed).

This allowed for a direct test of the range principle. In theory, the average rating given to the nine brushing frequencies should be equal between the two groups, because the average brushing frequency was the same for both groups. Any significant difference in the sum of subjective health ratings between the two groups could therefore only be

accounted for by the proximity of the frequencies to the minimum and maximum values in each group.

Comparing morning and evening brushing

Finally, in order to test whether or not morning and evening toothbrushing were viewed as equally important for health, parents in each group completed two more exercises where they saw the same weekly brushing frequencies as they had in the first exercise, but with added information about how often children's teeth were brushed in the morning and the evening.

In one exercise, they were shown information whereby parents tended to brush their child's teeth more often in the morning. In the other exercise, they were shown information whereby parents tended to brush their child's teeth more often in the evening (Table 6.3). A parent who brushed their child's teeth 7 times per week might be shown as brushing their teeth 7 times in the morning and 0 times in the evening for one exercise, then shown as brushing their teeth 0 times in the morning and 7 times in the evening for the other exercise. The order of the exercises was purposely counterbalanced to avoid potentially confounding order effects: half of the participants were presented with morning-biased brushing frequencies first, whereas half of the participants were presented with evening-biased brushing frequencies first.

For both exercises, parents were once again asked to rate each of the brushing frequencies on the 0 (least healthy) to 10 (most healthy) scale.

Brushing frequency	Morning biased		Evening biased	
	am	pm	am	pm
0	0	0	0	0
2	2	0	0	2
3	3	0	0	3
4	4	0	0	4
5	5	0	0	5
6	6	0	0	6
7	7	0	0	7
8	7	1	1	7
9	7	2	2	7
10	7	3	3	7
11	7	4	4	7
12	7	5	5	7
13	7	6	6	7
14	7	7	7	7
15	8	7	7	8
16	9	7	7	9
21	14	7	7	14

Table 6.3: Study 3: 'Morning-biased' and 'evening-biased' brushing frequencies presented to participants

Debrief

Upon completion of the exercise, participants were thanked and given a debrief sheet (Appendix 6) which explained the nature and aims of the study and provided contact details in case they had any further questions after the researcher had left. They were then presented with the shopping voucher.

Randomisation

Within each group, the order in which the nine brushing frequencies were presented was changed for each participant by random permutation, carried out using the “rand()” function in Microsoft Excel.

6.2.3. Piloting work

The exercise was piloted with eight parents before the main fieldwork was undertaken. The parents were recruited and paid using the same procedure followed for the main study.

The pilot work utilised a form of cognitive interviewing called 'think aloud testing' (Willis, 2005). Participants were asked to complete the exercise as normal, but to verbalise their thought process as they read each instruction and completed the exercise.

The researcher made notes during each exercise and assessed the following aspects of the exercise sheet:

- The general readability of questions and instructions
- Whether participants interpreted the instructions correctly
- Whether participants tended to use the full range of answer options
- Whether questions relying on recall were too burdensome for the participants or likely to involve calculations that could introduce human error
- Whether the overall length of the exercise was acceptable to participants
- Whether any of the questions were deemed too personal or intrusive

Several changes were made to the exercise sheet as a result of the piloting, a summary of which are shown in Table 6.4. Because the process and materials were subsequently amended, the data of the participants who took part in the pilot study were not included in the final analysis

Reference	Observation	Changes made
Covering letter, information sheet	Parents felt that the length of time each exercise took and the payment should be made more clear, to encourage parents to take part	Made each reference to exercise duration and payment bold on both covering letter and information sheet
Information sheet	A couple of parents said they were unsure that all parents would want to conduct the exercise at home	Emphasised the fact that parents could conduct the study at child's school, or place of work, etc.
Exercise sheet	Parents tended to skip guidance information	Simplified instructions at the top of each page, and made them clearer by adding shading to the box
Exercise sheet (page 1)	Some uncertainty about whether a 'normal week' would include weekends in reference to weekly brushing frequency	Added (Monday – Sunday) in parentheses after 'normal week'
Exercise sheet (page 1)	Some parents whose children brushed their teeth in school were uncertain whether to include this in weekly brushing	Emphasised that only toothbrushing carried out at home should be included
Exercise sheet (page 2)	Some parents circled one of the brushing frequencies (to match their own child's brushing frequency)	Made instructions clearer, that participants only needed to read the table before moving on to following page
Exercise sheet (page 3-5)	A number of parents only assigned a rating to one of the brushing frequencies in the table (usually the first)	Made instructions clear that parents needed to assign a rating to each brush frequency, and added a verbal cue to do so when conducting exercises
Exercise sheet (page 2-5)	Some confusion as to whether brushing frequencies referred to how often parents brushed their own teeth or their child's	Made it clear that brushing frequencies referred to how often parent brushed their child's teeth, not their own
Exercise sheet (page 2-5)	Some parents unclear about distinction between parent brushing child's teeth and child brushing own teeth	Changed instructions to indicate that frequencies referred to combination of parent brushing child's teeth and child brushing own teeth

Table 6.4: Study 3: Summary of changes made to materials as a result of piloting work

Finally, socio-economic status was calculated by using each participant's home post code (provided on the consent form), and assigning a deprivation quintile (1 = least

deprived, 5 = most deprived) based on the Welsh Index of Multiple Deprivation (Welsh Government, 2011)

6.2.4. Data analysis

Sample size calculation

As there had been no similar work in this area within the field of oral health before, it was not possible to perform an *a priori* power calculation. The sample size for the study (n=120, 30 per group) was instead based on previous studies utilising a similar experimental design (Wood et al., 2012b), and effect sizes are reported for the main statistical tests.

Statistical tests

Data were entered and analysed using SPSS v20 (IBM, 2011).

To test the rank principle between Group 1 and Group 2, a two-factor mixed factorial ANOVA was used. Group (Group 1, Group 2) was a between subjects factor and brushing frequency (5 times per week, 8 times per week, 11 times per week) was a within subject factor. Analysis tested for main effects of brushing frequency and group, and for an interaction between the two factors. As is recommended with a mixed factorial ANOVA, effect sizes for significant findings are reported using the eta squared statistic (η^2) (Cohen, 1973).

One-way ANOVAs were used to test mean differences between the two groups in terms of parents' ratings of their own child's brushing frequency and their estimated 'norm' for weekly brushing frequency. For one-way ANOVAs, effect sizes for significant findings are reported using the Cohen's *d* statistic (Cohen, 1992).

To test the range principle, a one-way ANOVA was used to test mean differences in the average scores allocated to all nine brushing frequencies, with group (Group 3, Group 4) as the between subjects factor. To further test the range principle, a one-way ANOVA was employed to look at the mean healthiness score that each group assigned to the '14 times per week' frequency, which was common to both groups and ranked

the same (3rd out of 9) in both. As above, one-way ANOVAs were used to test mean differences between the two groups in terms of parents' ratings of their own child's brushing frequency and their estimated 'norm' for weekly brushing frequency.

Finally, differences in subjective health ratings between morning brushing and evening brushing were analysed using a two-factor mixed factorial ANOVA, with group (Group 1, Group 2, Group 3, Group 4) as a between subjects factor and morning or evening bias (morning-bias v evening-bias) as a within subjects factor.

For each participant, a measure of socio-economic status was derived from their home post-code (provided on the consent form). Participants were allocated to one of five deprivation quintiles, assigned using the Welsh Index of Multiple Deprivation (Welsh Government, 2011) ranging from WIMD = 1 (least deprived) to WIMD = 5 (most deprived).

6.2.5. Research ethics

Ethical approval for the study was granted by Cardiff University Dental School Research Ethics Committee (Appendix 7). The committee reviewed and approved a study protocol as well as the written materials for the study, including consent forms, information sheets, covering letters, exercise sheets and letters to be sent to school headteachers.

6.3. Results

6.3.1. Participants

Table 6.5 summarises details of the study participants and their children. Due to some item non-response, baseline figures vary slightly for some variables.

Variable	Group	N	Mean	Standard deviation	Min value	Max value
Frequency with which parents report brushing child's teeth (weekly)	G1	30	12.97	2.47	7	21
	G2	31	13.00	2.35	8	21
	G3	30	13.10	2.78	5	21
	G4	30	12.90	2.58	7	21
	Overall	121	12.99	2.52	5	21
Child's age (in months)	G1	28	60.39	10.99	40	81
	G2	30	61.83	12.44	34	81
	G3	29	59.76	13.34	38	75
	G4	30	59.30	13.61	25	74
	Overall	117	60.32	12.53	25	81
Group		Male n (%)	Female n (%)			
Child's gender	G1	15 (50.0)	15 (50.0)			
	G2	12 (41.3)	17 (58.7)			
	G3	20 (66.7)	10 (33.3)			
	G4	11 (36.7)	19 (63.3)			
	Overall	58 (48.7)	61 (52.3)			
Group		WIMD=1 n (%)	WIMD=2 n (%)	WIMD=3 n (%)	WIMD=4 n (%)	WIMD=5 n (%)
Parental socio-economic status	G1	2 (7.1)	2 (7.1)	6 (21.4)	9 (32.1)	9 (32.1)
	G2	1 (3.4)	0 (0.0)	10 (34.5)	6 (20.7)	12 (41.4)
	G3	0 (0.0)	2 (6.9)	6 (20.7)	10 (34.5)	11 (37.9)
	G4	1 (3.3)	4 (13.3)	7 (23.3)	7 (23.3)	11 (36.7)
	Overall	4 (3.4)	8 (6.9)	29 (25.0)	32 (27.6)	43 (37.0)

Table 6.5: Study 3: Participant demographics

Socio-economic status was derived from post code data, and coded in to quintiles using the Welsh Index of Multiple Deprivation (WIMD), where 1 is the least deprived and 5 is the most deprived.

A one-way ANOVA showed that there was no significant differences between the groups in terms of the mean frequency with which parents reported brushing their child's teeth ($F(3, 117)=0.03$, $p=0.99$) or the child's age ($F(3,113)=0.23$, $p=0.88$). Chi-square analysis showed that there was no significant difference in the distribution of WIMD quintiles between the groups ($\chi^2 =9.09$, $p=0.70$), or any significant imbalance in children's gender ($\chi^2 = 6.26$, $p=0.10$) between groups.

6.3.2. Testing the rank principle of Range-Frequency Theory

Table 6.6 shows the mean healthiness ratings assigned to each of the brushing frequencies shown to participants in Group 1 and Group 2. Possible ratings ranged from 1 (least healthy) to 11 (most healthy).

Weekly brushing frequency	Group 1					Group 2				
	N	Mean	St. Dev	Min value	Max value	N	Mean	St. Dev	Min value	Max value
2	30	1.17	0.46	1	3	31	1.13	0.43	1	3
3						31	1.58	0.77	1	3
4						31	2.39	1.23	1	5
5	30	3.13	1.89	1	6	31	3.65	1.82	1	8
6	30	3.83	2.12	1	8					
7	30	4.63	2.14	1	8					
8	30	5.50	2.56	1	11	31	5.29	1.94	1	10
9	30	6.53	2.54	1	11					
10	30	7.63	2.25	1	11					
11	30	8.13	2.37	1	11	31	7.03	2.09	3	10
12						31	8.32	1.70	4	11
13						31	9.63	1.13	8	11
14	30	10.66	0.94	7	11	31	10.35	1.08	7	11

Table 6.6: Study 3: Comparison of health ratings assigned to different brushing frequencies, by group (Group 1 v Group 2)

There was a main effect of brushing frequency on the mean healthiness rating across the two groups ($F(1,59)=188.68$, $p<0.001$), whereby '11 times per week' was rated as generally more healthy than '8 times per week', which was in turn rated as generally more healthy than '5 times per week'.

When averaging the ratings assigned to 5, 8 and 11 times per week, there was no overall difference in healthiness ratings between the two groups ($F(1,59)=0.33$, $p=0.57$).

However, there was a significant interaction effect between group membership and brushing frequency ($F(1,59)=6.98$, $p=0.01$; $\eta^2=0.08$). The effect is illustrated in Figure 6.5.

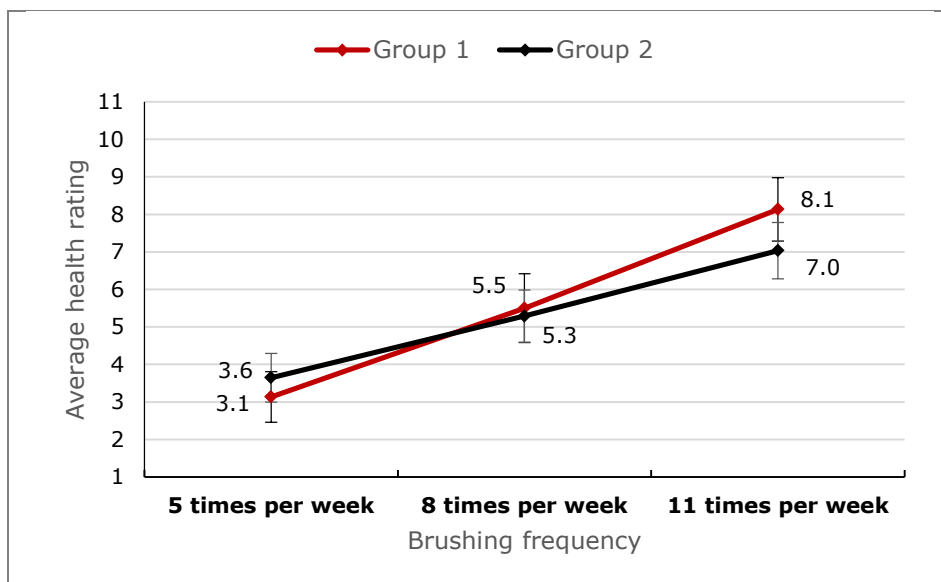


Figure 6.5: Study 3: Average healthiness ratings assigned to brushing frequencies by group (Group 1 v Group 2) with 95% confidence intervals

As predicted by the rank principle of Range-Frequency Theory, participants in Group 1 rated '5 times per week' as less healthy than participants in Group 2. The only way that the '5 times per week' frequency differed between groups was the fact that it was ranked lower among the other brushing frequencies presented to parents in Group 1 (rank = 8th out of 9) compared to its rank in Group 2 (rank = 6th out of 9). Conversely, parents in Group 1 rated the '11 times per week' brushing frequency as more healthy than those in Group 2. Again, the only way that this item differed between the groups was in its rank position among all brushing frequencies shown to parents. It was ranked

higher in Group 1 (rank = 2nd out of 9) compared to Group 2 (rank = 4th out of 9). No difference in health ratings was observed for the '8 times per week' frequency, which had the same rank in both groups (rank = 5th out of 9). This significant interaction effect therefore suggests that parents' judgements about toothbrushing frequencies comply with the rank principle of Range Frequency Theory. If parents made absolute judgements about the healthiness of different brushing frequencies, there should have been no difference in the ratings assigned to the '5 times per week' and '11 times per week' frequencies between the two groups.

6.3.3. Testing the range principle of Range-Frequency Theory

Table 6.7 shows the mean healthiness ratings assigned to each of the brushing frequencies shown to participants in Group 3 and Group 4. Possible ratings ranged from 1 (least healthy) to 11 (most healthy).

Weekly brushing frequency	Group 3					Group 4				
	N	Mean	St. Dev	Min value	Max value	N	Mean	St. Dev	Min value	Max value
0	30	1.00	0.00	1	1					
5						30	2.23	1.76	1	8
6	30	3.73	1.53	1	7	30	2.73	1.96	1	8
7	30	5.07	1.64	1	8	30	3.90	2.31	1	9
8						30	4.67	2.43	1	10
9						30	4.97	2.25	1	10
10						29	6.07	2.27	1	10
11	30	7.63	1.99	3	11					
12	30	8.67	1.67	3	11					
13	30	9.73	1.26	7	11					
14	30	10.53	0.94	7	11	30	9.33	1.79	3	11
15	29	10.48	0.95	7	11	30	9.43	1.94	2	11
16	30	10.80	0.48	9	11					
21						30	10.23	1.38	6	11

Table 6.7: Study 3: Comparison of health ratings assigned to different brushing frequencies, by group (Group 3 v Group 4)

There was a significant main effect of group on the average healthiness rating of all items ($F(1,58)=28.70$, $p<0.001$; $d=0.33$), whereby participants in Group 3 rated the nine brushing frequencies as significantly more healthy on average than those in Group 4 (Figure 6.6).

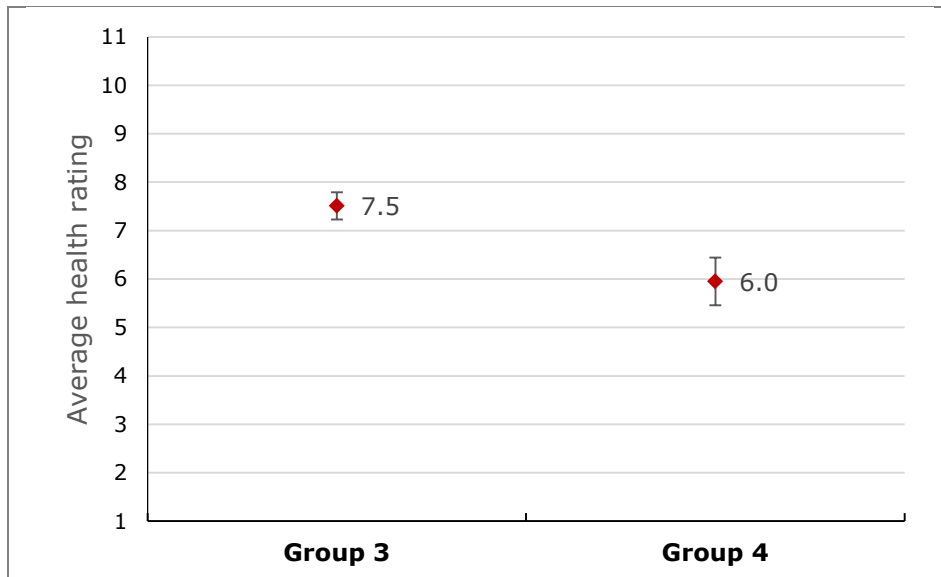


Figure 6.6: Study 3: Average healthiness rating given to all items by group (Group 3 v Group 4) with 95% confidence intervals

The nine brushing frequencies shown to the two groups had the same mean and sum value. If parents were making absolute judgements about the healthiness of brushing frequencies, there should have been no difference in the average ratings assigned to the nine items. This significant difference between the two groups is therefore consistent with the range principle of Range-Frequency Theory: the only difference between the two groups was that parents in Group 4 saw frequencies which were generally further away from the top of the range (the distribution was positively skewed, with a maximum value of 21 times per week) whereas those in Group 3 saw frequencies which were generally quite close to the top of the range (the distribution was negatively skewed, with a maximum value of 16 times per week).

The range effect is further illustrated by the average healthiness ratings assigned to the '14 times per week' brushing frequency by both groups (this item was ranked 7th out of 9 in both groups). Participants in Group 4 rated this frequency as being significantly less healthy than those in Group 3 ($F(1,58)=10.60$, $p<0.01$; $d=0.08$). This difference is

illustrated in Figure 6.7. Again, the only difference between the two groups is that the '14 times per week' item was further away from the top of range in Group 4 (21 times per week) than in Group 3 (16 times per week). In both groups, it had the same rank (rank = 3rd out of 9).

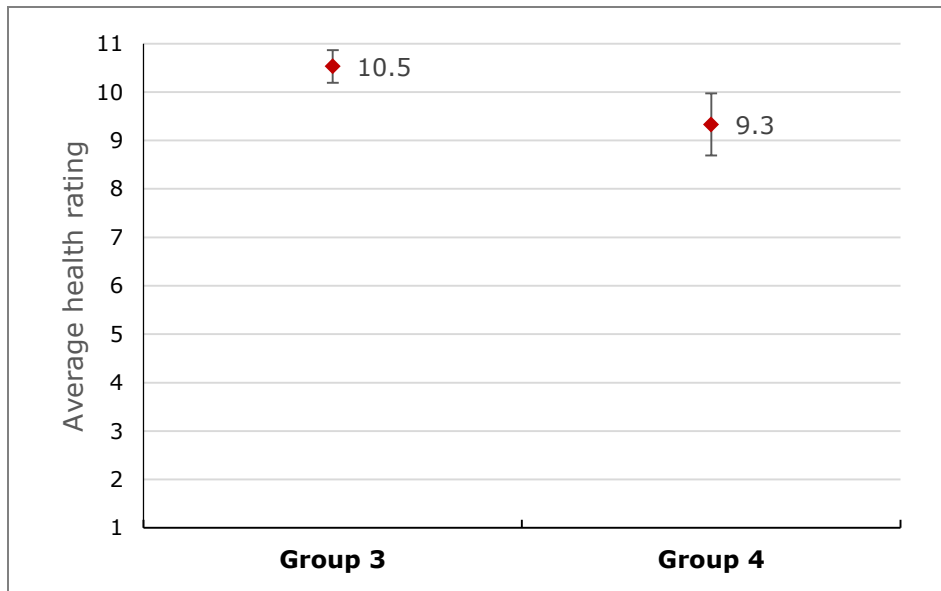


Figure 6.7: Study 3: Average health rating (1-11) given to 14 times per week frequency, by group (Group 3 v Group 4) with 95% confidence intervals

6.3.4. Contextual information and rating of own child's brushing routine

Figure 6.8 shows the average healthiness rating given by parents in Group 1 and Group 2 to their own child's brushing frequency. There was no significant difference between ratings given by the two groups ($F(1,59)=0.03$, $p=0.87$).

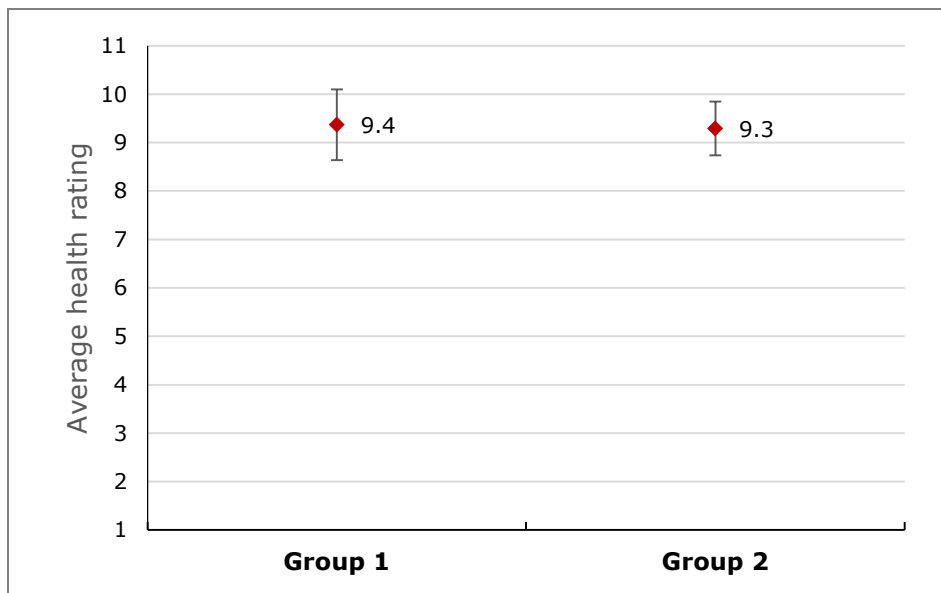


Figure 6.8: Study 3: Average health rating (1-11) given to own child's brushing routine, by group (Group 1 v Group 2) with 95% confidence intervals

However, participants in Group 4 rated their own child's brushing routine as significantly less healthy than participants in Group 3 ($F(1,57)=5.20$, $p=0.03$; $d=0.15$), despite no difference in the frequency which parents in the two groups reported brushing their child's teeth (Figure 6.9).

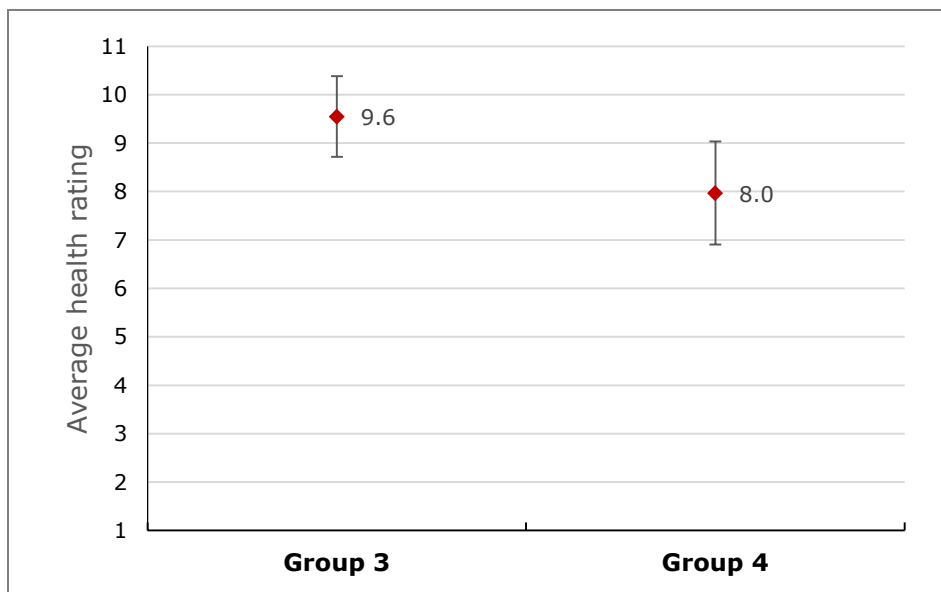


Figure 6.9: Study 3: Average health rating (1-11) given to own child's brushing routine, by group (Group 3 v Group 4) with 95% confidence intervals

6.3.5. Contextual information and perceived norms

Figure 6.10 shows parents' estimate of the 'norm' for weekly brushing frequency, which did not significantly differ between participants in Group 1 and Group 2 ($F(1,59)=0.82$, $p=0.37$).

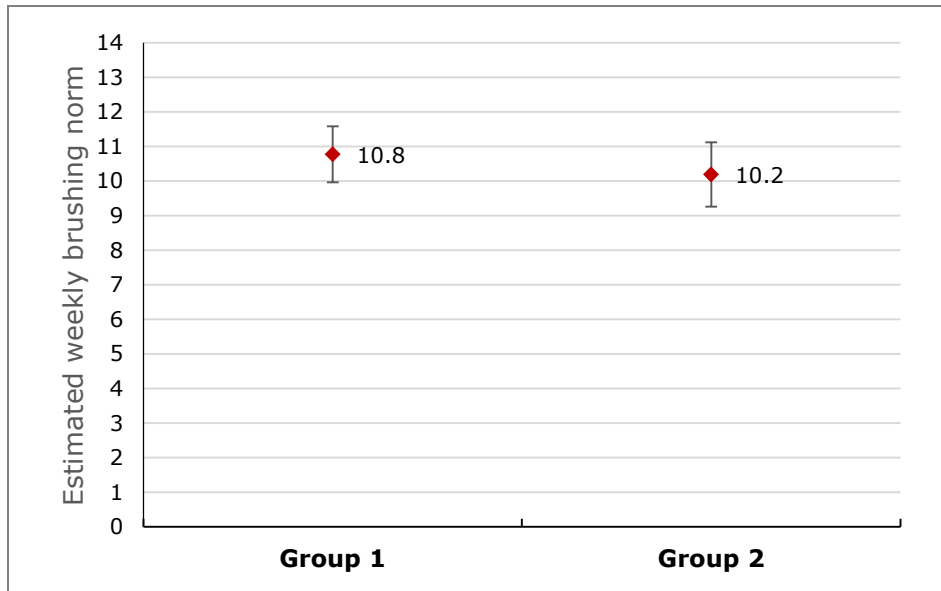


Figure 6.10: Study 3: Estimated 'norm' for weekly brushing frequency, by group (Group 1 v Group 2) with 95% confidence intervals

Finally, Figure 6.11 shows that participants in Group 4 estimated that the 'norm' for weekly brushing frequency was higher than those in Group 3, but this difference was not statistically significant ($F(1,57)=0.87$, $p=0.36$).

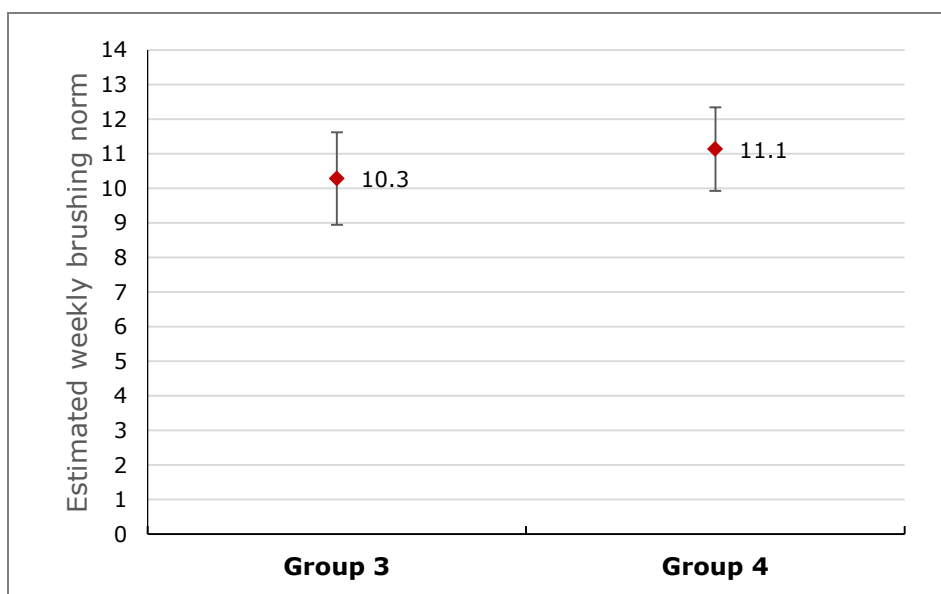


Figure 6.11: Study 3: Estimated 'norm' for weekly brushing frequency, by group (Group 3 v Group 4) with 95% confidence intervals

6.3.6. Morning and evening brushing

Table 6.8 shows the mean healthiness ratings assigned to the different morning-biased and evening-biased brushing frequencies, across all four groups.

Weekly brushing frequency	Morning-biased						Evening-biased					
	Shown as	N	Mean	St. Dev.	Min value	Max value	Shown as	N	Mean	St. Dev.	Min value	Max value
0	0 am 0 pm	30	1.17	0.91	1	6	0 am 0 pm	29	1.17	0.93	1	6
2	2 am 0 pm	59	1.17	0.42	1	3	0 am 2 pm	59	1.27	0.52	1	3
3	3 am 0 pm	31	1.68	1.01	1	5	0 am 3 pm	32	1.97	1.84	1	11
4	4 am 0 pm	31	1.97	1.08	1	4	0 am 4 pm	31	2.06	1.26	1	6
5	5 am 0 pm	89	2.85	1.78	1	7	0 am 5 pm	91	2.98	1.87	1	11
6	6 am 0 pm	89	3.53	1.88	1	8	0 am 6 pm	88	3.65	1.91	1	7
7	7 am 0 pm	89	4.06	2.24	1	9	0 am 7 pm	89	4.38	2.12	1	9
8	7 am 1 pm	90	4.81	2.07	1	10	1 am 7 pm	91	4.98	2.26	1	11
9	7 am 2 pm	58	5.19	2.65	1	11	2 am 7 pm	60	5.60	2.71	1	11
10	7 am 3 pm	59	5.95	2.79	1	11	3 am 7 pm	60	6.53	2.75	1	11
11	7 am 4 pm	90	7.08	2.19	1	11	4 am 7 pm	90	7.32	2.11	1	11
12	7 am 5 pm	61	8.59	1.48	5	11	5 am 7 pm	60	8.35	1.58	4	11
13	7 am 6 pm	61	9.41	1.54	5	11	6 am 7 pm	59	9.20	1.72	1	11
14	7 am 7 pm	120	10.22	1.36	5	11	7 am 7 pm	119	10.07	1.72	1	11
15	8 am 7 pm	60	9.53	2.35	1	11	7 am 8 pm	59	9.92	1.92	1	11
16	9 am 7 pm	30	10.53	1.11	6	11	7 am 9 pm	29	10.07	2.24	1	11
21	14 am 7 pm	30	9.93	1.91	3	11	7 am 14 pm	29	10.00	1.81	4	11

Table 6.8: Study 3: Mean health ratings assigned to the various morning-biased and evening-biased brushing frequencies

Overall, there was no significant difference between average ratings assigned to morning-biased brushing frequencies compared to evening-biased brushing frequencies ($F(1,115)=0.72$, $p=0.40$) (Figure 6.12). There was also no significant interaction between ratings assigned to morning and evening-biased frequencies and group membership ($F(3,115)=2.08$, $p=0.10$)

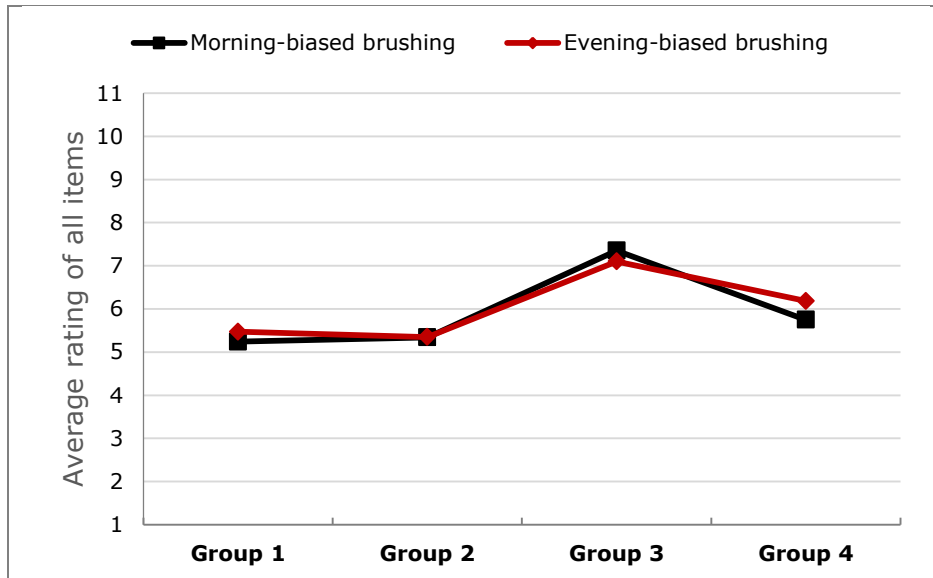


Figure 6.12: Study 3: Average ratings given to morning and evening-biased brushing frequencies by group

6.4. Discussion

The purpose of this final study was to develop one of the themes identified and explored in Study 1 (Chapter 4) and Study 2 (Chapter 5). The decision to develop the idea of toothbrushing norms – rather than toothbrushing motivation, or toothbrushing context - was based on the fact that Range Frequency Theory offered a clear framework for designing an experimental study. The final chapter of the thesis, the General Discussion (Chapter 7) considers how these other two themes might be further developed through future work.

6.4.1. Key findings

Range and rank effects

The results of the study showed that parents' judgements about the healthiness of various weekly toothbrushing frequencies adhered to the rank and range principles of Range Frequency Theory. Parents tended to rate toothbrushing frequencies as more healthy when they were ranked relatively high among the other frequencies shown to them, and they ranked brushing frequencies as more healthy when they were closer to the maximum brushing frequency presented.

These findings add to a growing research base showing that the two principles of Range Frequency Theory can accurately predict people's relative judgements in areas such as alcohol risk perception, body image, happiness and satisfaction with salary (Wedell et al., 2005, Brown et al., 2008, Boyce et al., 2010a, Wood et al., 2011, Wood et al., 2012b). This is, however, the first study to show that the rank and range principles can be used to understand people's judgements about what represents a healthy oral hygiene routine.

Contextual effects on judging own child's routine

The results also demonstrated that showing parents different types of information about what others do, affected how healthy they rated their own child's brushing routine.

Parents in Group 4, who were shown an example of a parent who brushed their child 21 times a week (or 3 times a day), subsequently rated their own child's brushing frequency as significantly less healthy than those in Group 3. This difference existed despite parents from the two groups reporting similar frequencies for brushing their child's teeth at the beginning of the experiment.

This effect of showing people different information about what others do has been shown to influence people's subsequent judgements in other areas as well. Wood and colleagues, for instance, demonstrated that participants expressed less gratitude for being loaned a fixed amount of money or given a certain duration of help when they had previously been shown examples of people who had received more money or help (Wood et al., 2011). However, this is the first study to demonstrate that presenting different types of information about what other people do can influence people's view on the health of their own (or in this case, their child's) toothbrushing frequency.

The final aspect of this study investigated parents' views on the health merits of morning and evening brushing. Whereas Study 2 (Chapter 5) looked at parents' motivation for brushing their child's teeth at different times of day, the current study looked at whether parents thought there was any difference in terms of health in brushing children's teeth in the morning or evening. The results showed that parents saw no significant difference in terms of health between morning and evening brushing. For instance, parents saw no significant difference in terms of health between brushing a child's teeth every morning but never in the evening, and the reverse case of brushing a child's teeth every evening but never in the morning. This suggests that the fact that parents reported brushing their child's teeth more often in the morning, in Study 2 (Chapter 5), was not necessarily because they thought that was a more healthy approach, but perhaps due to personal preference (e.g., a focus on short-term benefits of brushing) or opportunity (e.g., more stable morning routines).

Again, this is the first study to directly test people's perception about whether morning and evening toothbrushing confer any different benefits in terms of health.

6.4.2. Methodological considerations, data quality and limitations

Although a number of steps were taken during the design and administration of the study to ensure data quality and rigor, some limitations of the study must be acknowledged. The following section considers the validity, reliability and generalisability of the results, and the way in which these limit any conclusions which can be drawn from the study findings.

Validity

One common criticism of experimental studies is that they may lack ‘ecological validity’ – that is, they may not be a realistic approximation of the way in which participants would make decisions in a similar ‘real world’ situation. In the current study, for instance, it is possible that parents were simply treating the brushing frequencies as numbers and comparing them with the other numbers presented. However, the instructions given to participants specifically mentioned that they should give an overall rating to the brushing frequencies, rather than comparing them to each other. Furthermore, when parents were verbally debriefed, they all indicated that they had understood the instructions and had assigned the ratings as instructed. While carrying out the exercise, many parents expressed surprise at how frequently or infrequently other parents had reported brushing their child’s teeth, further suggesting that parents were interacting with the exercises as expected.

The decision to offer parents payment for the study was taken to compensate parents for the time it took them to complete the exercise, and to encourage participation in the study. One of the possible disadvantages of this approach is that it might incline parents to take part in the study to obtain the voucher, but to put minimal effort in to answering the questions. However, observation during the completing of exercises and analysis of the distribution of parents’ answers to the questions suggested that this was not the case. There were no examples, for instance, of parents selecting the same answer option to each of the nine questions: descriptive analysis of the minimum and

maximum 'healthiness' ratings ascribed to the different brushing frequencies in each group showed that parents tended to use both extremes of the eleven-point scale, rather than choosing options near the centre. Parents almost always took at least 10-15 minutes to complete the exercise. Taken together, these observations suggest that the results of the study can be considered to reflect the reality of parents' views.

Reliability

One aspect of the study design that may have affected reliability was that the researcher was present when parents completed the questionnaires. Social desirability bias refers to the tendency for some participants to give answers which they think will be seen as more acceptable, and this bias may be heightened when forms are completed in the presence of another person (Fisher and Katz, 2000). In the current study, where the researcher was un-blinded as to participants' group allocation, another possibility is that the results may have been influenced by 'experimenter bias', where the researcher unconsciously behaves differently towards participants in different groups. While parents were completing forms, care was taken to avoid expressing any opinions about toothbrushing that might affect their answers. When some parents inevitably commented on the information about other children's toothbrushing frequencies for instance, the researcher specifically avoided expressing personal or any opinions. Parents were also reminded, before completing the exercise, that the results were anonymous and that there were "no right or wrong answers". Despite these steps, it is possible that some parents may have been influenced by the researcher's presence when answering questions. Future work might look to see if there would be any difference in findings if parents completed a similar, self-complete questionnaire.

The decision for the researcher to be present was taken primarily to help guide parents with the completion of a potentially difficult questionnaire. This helped to avoid measurement error by reducing instances of parents misunderstanding questions or ticking too many or too few boxes, for instance. It also allowed for greater

standardisation of the process, ensuring that all parents were given the same instructions and that they completed the questionnaire one page at a time, as intended.

One possibility is that there were some underlying differences between the four groups that were not measured and which influenced parents' judgements about the healthiness of toothbrushing frequencies. As the study population was deemed to be fairly homogenous in terms of demographics (socio-economic status, children's ages, etc.), it was deemed unnecessary to deliberately balance the groups by matching participants on certain traits. Indeed, the groups were well matched in terms of children's age, the frequency with which parents reported brushing their child's teeth and socio-economic status, suggesting minimal selection bias. While there was a difference between parents in Group 3 and Group 4 in terms of the proportion of male and female children, this difference was not statistically significant. The groups were otherwise well matched and the results of Study 2 (insert section reference here) suggested that there was no significant effect of children's gender on parents' reports of the child's toothbrushing frequency or other outcome measures being studied. It seems unlikely, then, that this gender imbalance would account for the group differences reported.

Generalisability

As the recruitment of parents was overseen by staff from the Community Dental Service, the number of parents who were approached but declined to take part in the study was not recorded. The process of recruiting participants was therefore to some extent opportunistic. As a result, the sample of parents may not be truly representative of the entire study population. Despite this, the distribution of deprivation quintiles and the average parent-reported brushing frequency of the children were very similar to those reported in Study 2 (Section 5.3.2)

As with the previous studies in this PhD, the sample population was deliberately skewed towards parents from areas of high socio-economic deprivation, and the parents were recruited from a defined geographical area. Consequently, the results

reported here may have limitations in their generalisability to wider populations. To improve the external validity of the findings, future research may seek to explore whether parents from different socio-economic backgrounds, or older children and adolescents exhibit the same tendency towards making relative judgements about toothbrushing frequency.

Methodological considerations

As with Study 2 (Chapter 5), demographic details (age, gender) of parents were not collected in the current study. Again, this was the result of piloting work which suggested that parents were more reluctant to take part in the study (or less co-operative) if they had to give personal details about themselves. Socio-economic status was calculated by using an area-based measure of deprivation derived from post-code data, but future work may wish to explore the effect of parents' age and gender on their perceptions about the healthiness of different toothbrushing frequencies.

As this was the first study to test the principles of Range Frequency Theory in relation to oral health, it was not possible to accurately estimate means on which to base an *a priori* sample size calculation. The sample size for each group was instead based on previous studies utilising the same experimental design. As a result, it is important to acknowledge the possibility of type II errors: that is, the chance that some of the non-significant findings may have been the result of a lack of statistical power. A larger sample size would have given more statistical power, but in the context of the current work, the sample size had to account for the time-intensive nature of the researcher visiting people's homes to supervise the pen and paper exercise.

6.4.3. Conclusions

This study is the first to apply the principles of Range Frequency Theory to trying to understand parents' decisions about what constitutes a healthy number of times to brush a child's teeth each week. The results show that decisions about toothbrushing are influenced by the same cognitive processes (the rank and range principles) that

predict people's judgements in a wide variety of other psycho-physical and social psychology fields.

Importantly, the results show that parents' judgements about how healthy their own child's toothbrushing routine is can be influenced by presenting different forms of information about what others parents do. Participants shown information suggesting that other parents brush their child's teeth three times a day expressed less satisfaction with their own child's brushing routine. Assuming that parents who are less satisfied with how often they brush their child's teeth will be more motivated to improve their behaviour, this opens up a range of possibilities for designing oral health education messages or interventions which might bring about behaviour change through giving people different types of information about what their peers do.

6.5. Chapter summary

The current chapter reported on findings from an experimental study completed by 121 parents of children aged 3-6 years old, from socio-economically deprived areas of South East Wales. The experimental study built on the findings of previous studies, and explored in more depth the cognitive processes behind parents' appraisals of different toothbrushing frequencies using Range Frequency Theory as a theoretical framework. The study was also designed to test the effect of presenting different types of information about what other people do on parents' subsequent ratings of their own child's brushing routine and their estimates of the norm for brushing.

A number of the findings are novel to oral health, including:

- The idea that parents' judgements about different toothbrushing frequencies adhere to the range and rank principles of Range Frequency Theory
- The idea that presenting parents with different information about what other parents do might affect how healthy they think their own child's toothbrushing routine is
- The idea that parents did not assign any more value in terms of health to brushing their child's teeth more often in the morning or more often in the evening

The limitations of the study, and some of the methodological considerations were also considered.

The following chapter, the General Discussion, considers the key findings, limitations and implications of the PhD project as a whole.

7. GENERAL DISCUSSION

This chapter considers the key findings, limitations and implications of the PhD project as a whole.

The overall aim of the PhD project was:

To explore the way in which wider social, environmental and cognitive factors might influence parents' decisions about when and how often they brush their children's teeth at home, in order to inform future oral health advice aimed at parents and identify relevant theoretical frameworks for behaviour change interventions.

This was addressed by conducting three separate studies. The first section of this chapter (7.1) looks at the key findings from each of the three studies, in relation to their specific aims. The second section (7.2) considers patterns of findings across the PhD project as a whole, and the insights gained from synthesising the results of each study. While the limitations and potential sources of bias relating to each of the individual studies were considered in the Discussion section of the respective chapters, the third section (7.3) considers some of the wider methodological considerations of the project as a whole. The fourth section (7.4) considers some of the implications of the PhD's findings for practitioners, oral health educators and researchers working in dental public health. The fifth section (7.5) then summarises the recommendations for practitioners and the final section (7.6) looks at the conclusions of the PhD project.

7.1. Summary of key findings

7.1.1. Study 1

The aim of Study 1 was to:

Identify factors which influence parents' decisions about when and how often they brush their child's teeth at home

Fifteen parents were interviewed about their experiences of brushing their child's teeth at home. The key findings are summarised below:

- Three themes were developed from the transcripts: **toothbrushing motivation**, **toothbrushing context** and **toothbrushing norms**
- Parents were motivated to brush their children's teeth for primarily short-term reasons (cosmetic factors), but the motivation for brushing was different in the morning and the evening. Evening brushing was seen as having more long-term benefits.
- Toothbrushing was embedded in family's daily activities, and parents' day-to-day routines appeared to influence when and how often they brushed their child's teeth. Parents who brushed their children's teeth twice a day referred to the behaviour as a 'habit'.
- Parents were aware of the idea that they *should* brush their child's teeth twice a day, but not all parents took the advice seriously – most parents automatically made comparisons with what they imagined most other parents did

7.1.2. Study 2

The aim of Study 2 was to:

Measure the factors identified in Study 1 and determine how they relate to the frequency with which parents brush their child's teeth at different times of day

In total, 297 parents completed a questionnaire survey about their child's brushing habits and other factors such as their perception of how often other children had their teeth brushed (perceived social norms), their self-reported habit for brushing their child's teeth and their motivation for brushing their child's teeth at different times of day.

The study's key findings were:

- Parents' estimate of how often an 'average' child had their teeth brushed each week were significantly associated with how often they reported brushing their own child's teeth: parents who thought others brushed more often reported brushing their own child's teeth more often
- Parents' satisfaction with their child's toothbrushing frequency was significantly associated with how much better or worse they thought it was compared to an 'average' child, even when controlling for self-reported brushing frequency
- There was a significant difference between parents' motivation to brush their child's teeth in the morning (more short-term) compared to the evening (more long-term)
- Parents' reported brushing children's teeth significantly more often in the morning than the evening
- Parents who were motivated by short-term factors tended to brush their child's teeth less often in the evening
- Parents for whom brushing their child's teeth was more automatic or 'habitual' reported brushing their child's teeth more often in the morning and evening

- Having a stable day-to-day routine was associated with a stronger habit for brushing a child's teeth, both in the morning and evening

7.1.3. Study 3

The aim of Study 3 was to:

Explore in more depth one of the factors identified in Study 1 and Study 2, in order to identify possible mechanisms for changing parents' behaviour through oral health education or interventions

An experimental study was conducted, with 121 parents divided into four groups and shown information about how often other parents brushed their children's teeth. The key findings were:

- Parents rated toothbrushing frequencies as being more healthy when they ranked highly among other brushing frequencies presented at the same time (as predicted by the rank principle of Range Frequency Theory)
- Parents rated toothbrushing frequencies as being more healthy when they were closer to the maximum brushing frequency shown to them (as predicted by the range principle of Range Frequency Theory)
- Parents who were shown examples of a parent who brushed their child's teeth 3 times a day (21 times per week) subsequently rated their own child's brushing frequency as being less healthy
- When parents were asked to evaluate the healthiness of different patterns of weekly brushing, overall brushing frequency was more important than whether brushing occurred more often in the morning or evening.

7.2. Integrating the findings

7.2.1. Cognitive factors: toothbrushing motivation

Parents' motivation or rationale for brushing their child's teeth was explored throughout the study (Figure 7.1).

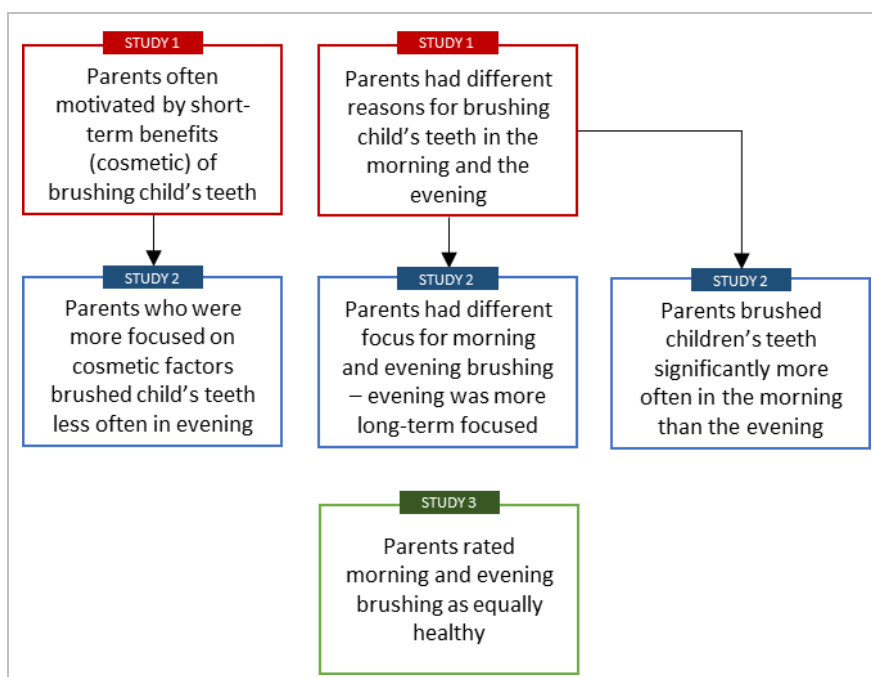


Figure 7.1: Summary of findings on parents' motivation for brushing their child's teeth

One of the important findings from the project was that the factors which determine how often parents brush their child's teeth may be different at different times of day. In the interview reported in Study 1 (Chapter 4), parents tended to distinguish between morning and evening brushing, often considering them as separate events (Section 4.3.3). One reason for this distinction was that parents saw the purpose of brushing in the morning as being related to their child's hygiene and appearance, ensuring that they were sent to school with clean teeth and fresh breath. In the evening, parents tended to see brushing as being a process of removing food, or 'keeping teeth healthy'. This was confirmed in Study 2 (Chapter 5), using a vignette where parents were asked to choose between different types of fictional toothpaste that they would use for brushing their child's teeth in the morning and the evening. There was a significant difference between parents' choices for morning and evening brushing, with parents

emphasising longer-term, health benefits for evening brushing and shorter-term, cosmetic benefits for morning brushing (Section 5.3.6).

The results of the two studies suggest that parents who think about brushing their child's teeth as having mostly cosmetic benefits may neglect evening brushing, or downplay its importance relative to morning brushing. In Study 2, the results showed that parents who were focused on the short-term benefits of toothbrushing (as evidenced by their choosing toothpastes with more of the 'fresh' ingredient) tended to brush their child's teeth less often in the evening (Section 5.3.6). This finding is consistent with some of the quotes from the interviews reported in Study 1. One parent who felt that the main reason for brushing their child's teeth was to help maintain their appearance explained that they didn't see the point in brushing their child's teeth in the evening "if they're brushing in the morning anyway". Another parent likened sending their child to school without brushing their teeth as like sending them in "with muddy trousers, or food all over them, and their hair all scruffy" suggesting that it was important to brush their child's teeth in order that they wouldn't be judged by school staff to be a bad parent (Section 4.3.3). Consistent with this idea that parents were particularly concerned about brushing their child's teeth in the morning, Study 2 showed that overall, parents reported significantly more morning brushing than evening brushing (Section 5.3.3).

Parents emphasising the short-term benefits of toothbrushing more than the long-term benefits is consistent with insights from the field of behavioural economics. Studies consistently show that people tend to exhibit a cognitive bias towards behaviours which have immediate rewards, relative to behaviours which have longer term rewards. This is often referred to as temporal or delay discounting (Frederick et al., 2002). This tendency is perhaps most clearly illustrated in money-choice questionnaires, where people might choose to receive an immediate reward of £10 rather than a reward of £15 in a month's time (Kirby and Marakovic, 1996). This myopia is more evident in some individuals than others, and the principle has been explored in relation to

people's health-related behaviour in terms of alcohol consumption, substance misuse, diet and exercise (Reynolds, 2006, Melanko and Larkin, 2013, Daugherty and Brase, 2010).

However, parents' judgements about what constitutes a healthy brushing routine appeared to be based largely on the total number of times a child's teeth are brushed, rather than necessarily when they are brushed. The results from Study 3 (Chapter 6) showed that parents did not assign significantly different ratings to examples of parents who brushed their child's teeth predominantly in the morning (e.g., 7 times in the morning each week, and 0 times in the evening) or predominantly in the evening (e.g., 0 times in the morning each week, and 7 times in the evening), so long as the weekly total was the same (Section 6.3.6). This is important, because it suggests that even though parents may be more motivated to brush their child's teeth at one particular time of day, they don't necessarily distinguish between morning and evening brushing in terms of its importance for their child's oral health. The tendency to brush children's teeth more often in the morning may reflect difference in motivation or opportunity, rather than a conscious decision that morning brushing is healthier.

7.2.2. Environmental factors: toothbrushing context

Parents' home environment was also explored in relation to when and how often parents brushed their child's teeth (Figure 7.2)

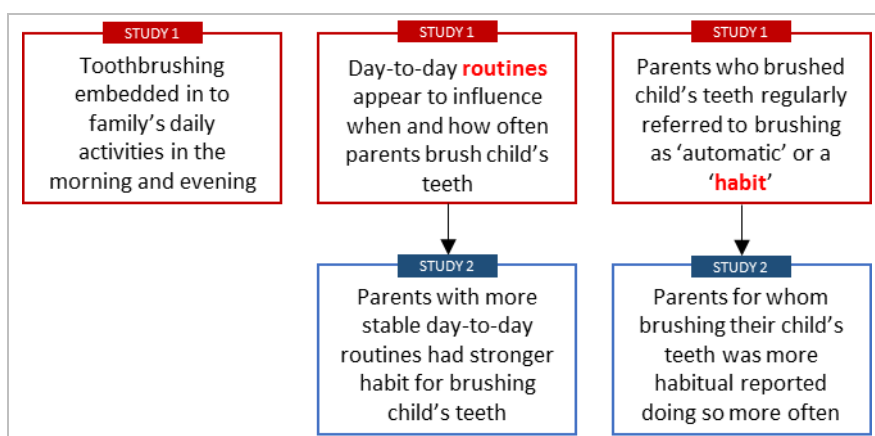


Figure 7.2: Summary of findings on parents' routines and habit for brushing their child's teeth

One of the key factors which appeared to differentiate between parents who brushed children's teeth regularly and irregularly was the extent to which parents had formed a toothbrushing 'habit'. Parents who reported brushing their child's teeth frequently in Study 1 often talked of a toothbrushing 'habit', explaining that brushing twice a day was "automatic" and "just something that happens" (Section 4.3.4). These descriptions are consistent with psychological theories of habits which argue that the key element in determining whether a behaviour can be considered habitual or not is 'automaticity' – where behaviour is cued by environmental stimuli, performed without conscious awareness, and with a limited ability to control the action (Orbell and Verplanken, 2010). In Study 2, parents completed a modified version of the Self-Report Habit Index (SRHI), which assesses the extent to which brushing was, for example, 'something I do automatically' and 'something I do without thinking' (Verplanken and Orbell, 2003). The measure showed good internal reliability and the habit scores were significantly associated with the number of times that parents reported brushing their child's teeth: parents who did not have a strong habit for brushing their child's teeth typically tended to miss more brushing throughout the course of a typical week (Section 5.3.6). The interviews in Study 1 suggested that establishing a habit was useful for both the parent (because there was less chance of forgetting to do it) and the child (children were used to brushing, and were less resistant to it). In contrast, those parents who didn't feel that brushing was a habit often spoke of there being certain days when children "played up" and didn't want to have their teeth brushed (Section 4.3.4).

Taken together, the results of Study 1 and Study 2 suggest that a parent's ability to form a regular habit of brushing their child's teeth may depend on the stability of daily routines and schedules. In Study 2, a multi-item measure of 'routine stability' was significantly correlated with the strength of a parents' habit for brushing their child's teeth, as measured by the Self-Report Habit Index (Section 5.3.6). Those parents with a more stable routine reported that brushing their child's teeth was more automatic. In Study 1, parents who brushed their children's teeth infrequently often referred to

chaotic schedules as being a limiting factor (Section 4.3.4). One parent, for instance, described their evening as being “just hectic, so you sometimes end up missing [brushing the child’s teeth]”. It is interesting to note that, in Study 2, the degree to which parents reported that brushing their child’s teeth was habitual was not associated with the child’s age or the age at which the parent had begun brushing the child’s teeth, but instead with the extent to which day-to-day activities followed a predictable pattern (Section 5.3.6). The findings are consistent with habit theories which suggest that actions become habituated or ‘automatic’ when regularly performed in stable contexts – “in particular locations, at specific times” (Wood et al., 2005).

Combining the results of the two studies also gives a broader view of the factors which might influence routines and habits. The interviews in Study 1 suggest that stable or unstable routines often appeared to be the result of external pressures such as a parent’s working patterns or after-school childcare arrangements, rather than individual-level factors such as a parent’s level of organisation or planning skills (Section 4.3.4). One parent explained that “I don’t know if I’m always going to be back in time [from work] to get everything done, so if I’m honest, it does mean we don’t always brush her teeth before bed”. Some of the parents interviewed clearly had quite chaotic lifestyles which made it difficult to establish any sort of consistent habit, despite their best intentions. Factors like day-to-day routines appear to be influenced by economic and environmental conditions as much as a parent’s personality or individual-level traits, demonstrating the importance of considering wider level (or more ‘upstream’) determinants of children’s toothbrushing frequency.

Two parental factors which have previously been identified as correlates of a child’s oral health are self-efficacy and locus of control (Adair et al., 2004, Lencova et al., 2008, Finlayson et al., 2007). Self-efficacy refers to a parent’s belief in their own ability to achieve the goal of brushing their child’s teeth twice a day, while locus of control refers to the extent to which a person believes that establishing a twice-daily brushing routine for their child is within their own control (internal) or influenced by factors

beyond their control (external). Both of these concepts are often interpreted as individual-level traits, whereby some parents may be naturally more confident in their abilities and knowledge about how to brush their child's teeth properly or have a tendency to see themselves as being in control of their own choices. However, another possibility is that a parent's confidence in their ability to brush their child's teeth regularly (self-efficacy) and their feelings of control (locus of control) is determined by economic and environmental constraints (e.g., work patterns) that affect their daily routines and schedules. For instance, a parent who has particularly unpredictable work shifts and relies on friends or grandparents for childcare in the evenings may understandably feel that brushing their child's teeth every evening is beyond their capability and control, regardless of their intentions. In the wider literature, there is evidence that children and adults from more deprived communities tend towards having less self-efficacy and a more external locus of control in general (Cabinet Office, 2008).

7.2.3. Social factors: toothbrushing norms

An important aspect of the work is that it serves to emphasise the fact that parents' decisions and judgements about their child's oral hygiene do not occur in a social vacuum. Instead, the results of the studies point to parents being influenced by what they think their peers do. The importance of social and contextual information was a consistent theme across the three studies (Figure 7.3).

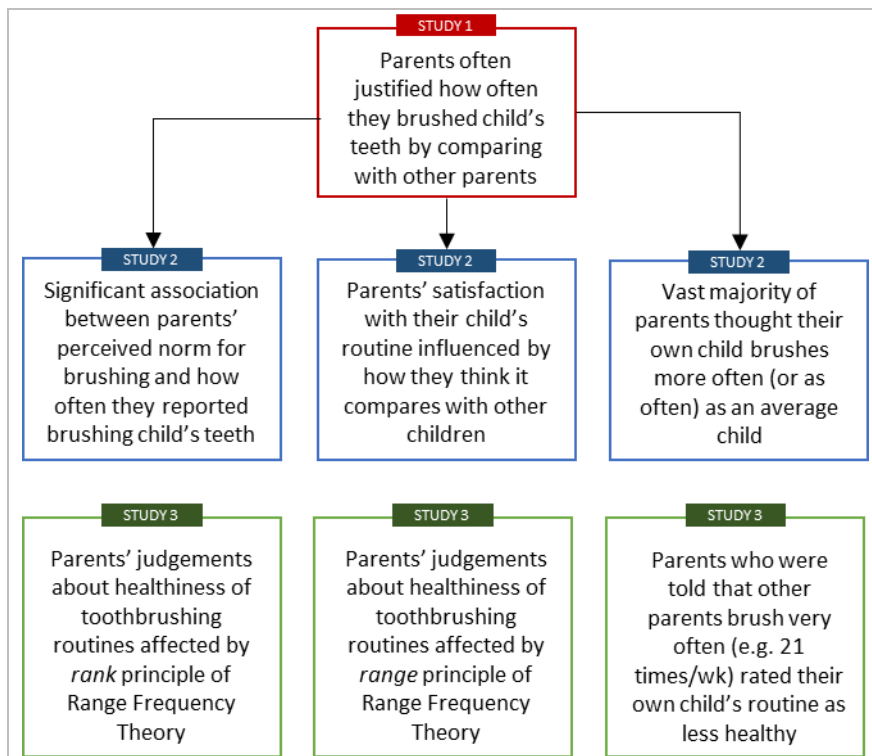


Figure 7.3: Summary of findings on parents' perceived norms and comparisons for brushing their child's teeth

In Study 1, there was a near universal tendency among the interviewees to reference other parents or children when reporting on, and justifying, how often they brushed their own child's teeth (Section 4.3.5). Study 2 then demonstrated a clear link between the frequency with which parents reported brushing their own child's teeth and what they believed others did, even when controlling for socio-economic and demographic factors (Section 5.3.4).

By combining both qualitative and quantitative research studies, it was possible to shed more light on the possible causal relationship between perceived norms and behaviour. Because of the cross-sectional nature of the questionnaire survey in Study 2, it was not possible to determine the direction of the relationship between parents' estimates of what other parents did and the frequency with which they reported brushing their own child's teeth. In other areas of health, people's normative perceptions may be informed by direct observation. Researchers in the field of alcohol, for instance, have argued that overestimations of the drinking norm might result from a form of recall bias, where observing other people drinking alcohol and being drunk is more salient than seeing

people drinking non-alcoholic drinks and being sober. However, with oral hygiene behaviour, direct observation is less likely. Several parents interviewed in Study 1 explicitly acknowledged that they did not know how often other parents brushed their child's teeth. Instead, the interviews suggested that parents simply use their own experience as a benchmark and assume that other parents act in a similar way (Section 4.3.5). This phenomenon of imagining that most other people behave or think in a similar way to oneself is known as the "false-consensus effect" (Ross et al., 1977). Thus, while the link between perceived norms and own behaviour is consistent with other findings in areas such as exercise, diet and alcohol use, the causal direction of the relationship may be different for toothbrushing. Rather than parents observing what others do and copying that behaviour, it may be that they behave in a certain way (e.g., brush their child's teeth just once a day) and then make an assumption that, because they find it difficult to brush their child's teeth twice a day, other parents must also experience the same difficulty and therefore behave in a similar way to themselves.

Finally, the results point towards the fact that parents' judgements about how often they should brush their child's teeth are relative rather than absolute. In Study 1, parents were aware of how often they *should* brush their child's teeth, but only took the 'twice a day' message seriously if they believed other parents followed it as well. Accordingly, some parents justified brushing their child's only once a day by insisting that this was what "most other parents" probably did. In Study 2, this effect was further demonstrated by showing that parents' satisfaction with their child's brushing frequency was determined by how much better or worse they thought it was compared to an average child, rather than by the brushing frequency alone. Study 3 developed this idea a step further, using an experimental study to show that parents' ratings of different weekly brushing frequencies were highly influenced by contextual factors – the same brushing frequencies were ranked more or less healthy according to how they ranked among the other brushing frequencies presented, or their distance from the maximum brushing frequency presented, consistent with the predictions of Range Frequency Theory.

Taken together, the results of the three studies suggest that parents do not have a fixed view of what constitutes a healthy number of times to brush a child's teeth each week. Rather, their views depend on whether they think their child's brushing routine compares favourably to others: it is a relative judgement, with similar cognitive underpinnings to decisions demonstrated in wider health fields.

7.3. Overall methodological considerations and limitations

7.3.1. Mixed-methods approach

Triangulation

One of the main advantages of using a mixed-methods approach was the ability to triangulate the findings of the three different studies. This had two main benefits for the current project. Firstly, there was a large degree of consensus in the findings from the three studies, which adds to the validity to the findings. For instance, the results from Study 1 suggested that parents had different reasons for brushing children's teeth in the morning and evening. These results are given extra validity by the results of the vignette from Study 2 showing parents' different choice of toothpastes for morning and evening brushing. Secondly, integrating the results from the different studies provided added insight and context for some of the findings. As discussed above, the interviews with parents in Study 1 helped with the interpretation of the cross-sectional association found in Study 2 between perceived norms for brushing and parents' reports of how often they brushed their child's teeth. Quotes from parents suggested that this association may be a case of parents assuming that other people behave similarly to them, rather than being influenced by what they see or hear about others doing. The original qualitative study was therefore useful for both generating ideas which informed the design and conduct of the following quantitative studies, and also for helping to provide some context to the subsequent quantitative findings.

Questionnaire development

One advantage of conducting a preliminary qualitative study was that the findings from that work were used to develop some of the measures employed in the subsequent questionnaire survey. For example, the results from Study 1 suggested that the extent to which a parent's daily routines and activities were stable and predictable might influence whether they developed a habit of brushing their child's teeth. However, a literature review suggested that there were no suitable existing tools for measuring the

concept of daily routines. Instead, a new multi-item measure was designed which aimed to measure the specific aspects of daily routines which parents had discussed in the interviews. Similarly, for other questions where there was judged to be no suitable validated measure, the wording of questions was influenced by quotes from the interviews with parents, and then further refined through pilot testing.

Utilising the advantages and offsetting the disadvantages of different research approaches

Qualitative and quantitative methods both have their strengths and weaknesses. Bryman (Bryman, 2006) considers that combining the two allows a researcher to offset the weaknesses while drawing on the strengths. For instance, while qualitative research is well suited to generating novel ideas, a common criticism is that the findings are not generalisable to wider populations because the sample population is usually small and selected using non-probability sampling. With a mixed-method approach, it was possible to generate ideas and hypotheses from the rich qualitative data obtained from interviewing a small sample of parents, before testing those hypotheses with a survey of a much larger sample of parents in Study 2. Likewise, by employing an experimental design in Study 3, it was possible to investigate potential pathways for changing parents' behaviour, overcoming some of the limitations of cross-sectional survey work.

7.3.2. Self-reported behaviour

A common limitation of each of the studies was that they relied on parents' self-reported behaviour. A reliance on self-report data is common to research in to many health-related behaviours, such as diet, physical activity, smoking, alcohol use and seatbelt use. In all of these areas, there is a risk that people will be motivated to report responses that they think will be seen as more socially acceptable. This is particularly relevant because most parents appeared to be aware of the idea of what they should ideally do in terms of brushing frequency. Efforts were made to mitigate against the

possibility of exaggerated answers in each of the three studies: by positioning the interviewer in Study 1 as a non-clinical researcher; by telling parents that there were no right or wrong answers and encouraging honesty; and by making clear to all parents who took part in the studies that the results would not be individually identifiable.

One method which may have provided more objective information would be to provide parents with an electronic toothbrush which records usage. However, such an approach would still risk giving biased results because of the likelihood that people would alter their behaviour when they knew it was being recorded. Furthermore, providing parents with electronic toothbrushes requires considerable resource when used on a larger scale, and was not considered suitable for the current project. Taking clinical measurements such as plaque levels or measuring dmft was another possibility, but due to the wide range of determinants for oral health outcomes, these measures would not necessarily have helped to validate parents' self-reports of how often they brushed their child's teeth.

7.3.3. The study population

Focusing on parents from areas of socio-economic deprivation

At the outset of the project, a decision was made to focus on parents from areas of high socio-economic deprivation. There has been much discussion in the oral health and wider health promotion literature about the effectiveness of different population approaches, with some researchers arguing that targeting interventions at whole populations is more beneficial than focusing on individuals or populations identified as high-risk (Rose, 1985, Burt, 2005, Watt, 2005). However, epidemiological data clearly shows that there is a social gradient in oral health outcomes for children in the UK, even at three and five-years old (McMahon et al., 2010, Welsh Oral Health Information Unit, 2012, Public Health England, 2013, Scottish National Dental Inspection Programme, 2014). Representative surveys have also shown that parents from more socio-economically deprived areas report brushing their children's teeth less often than

those from more affluent areas (White et al., 2006). One of the dangers in conducting this sort of research across a wider range of socio-economic groups is that the subsequent findings and recommendations may not be applicable to all parents. Previous reviews of oral health education have in fact shown that simply providing oral health advice to parents has the potential to actually widen inequalities, because parents from more affluent areas are better placed to implement the advice than those from more deprived areas (Kay and Locker, 1996). In the wider health promotion literature, authors have argued that “what is protective for low-SES individuals is not the same as what is protective for high-SES individuals, and this needs to be taken into account in interventions aimed at reducing health disparities” (Chen and Miller, 2013).

It must be acknowledged that focusing on parents from similar geographic areas and socio-economic backgrounds does limit the generalisability of the results. Further research may seek to explore the extent to which factors such as toothbrushing motivation, habit formation and perceived social norms differ across the socio-economic spectrum.

Sampling from Designed to Smile schools

Another potential source of bias is that parents and children were sampled from schools taking part in the Designed to Smile supervised toothbrushing scheme (Designed to Smile, 2014). Through their participation in the scheme, parents may have received information leaflets containing oral health advice, attended talks or have been more conscious about toothbrushing because of their child discussing it at home. As a result, the parents sampled may have had more awareness about oral health issues than other parents from similar socio-economic backgrounds. This may have inflated the average weekly brushing frequency reported by parents, either because they genuinely did brush their children’s teeth more often, or because they were more aware that they should brush their child’s teeth twice a day and so were more susceptible to social desirability bias.

7.3.4. Using toothbrushing frequency as an outcome measure

The project specifically focused on one element of oral hygiene: that is, the frequency with which children's teeth are brushed. Other factors such as the duration of brushing, brushing technique and rinsing behaviours might also have been considered as potential determinants of the effectiveness of toothbrushing with fluoride toothpaste. There were two main reasons that the project focused on toothbrushing frequency over these other factors. Firstly, brushing duration and brushing technique are very difficult to measure within the context of cross-sectional surveys. Capturing this sort of information would require either observational studies, lab-based or clinical studies or the collection of data through retrospective diaries. These approaches would be more resource intensive, and require greater burden on participants. Given the difficulty of recruiting patients to simple questionnaire survey studies, it would likely have been very difficult to obtain a large enough sample to produce meaningful results. There would also have been a large risk of bias through 'observer bias', where the act of watching somebody, or asking them to regularly record their actions would likely change their normal patterns of behaviour. Secondly, the evidence base for the relationship between brushing frequency and caries risk is extremely strong (Marinho et al., 2003c). In comparison, there is very little evidence base for the effect of brushing duration on caries prevention. For instance, a recent Scottish national clinical guideline document on *Dental Interventions to Prevent Caries in Children* involved a systematic review of the literature and concluded that "there is insufficient evidence on which to recommend a specific duration for an episode of toothbrushing for the prevention of caries" (Scottish Intercollegiate Network Guidelines, 2014).

7.3.5. Focusing on parental factors

The focus of the current work was on understanding how parents make decisions about brushing their child's teeth. Accordingly, the concepts and themes explored were primarily related to parental factors as determinants of a child's toothbrushing

frequency. However, it is important to acknowledge that a parent brushing a child's teeth is an interaction between two parties. Previous studies have suggested that some parents report children being 'difficult' as a barrier to establishing a regular brushing routine (Spitz et al., 2006). Therefore, one factor which may influence or limit a parents' ability to brush their child's teeth regularly is the behaviour or temperament of the child themselves.

7.4. Implications

7.4.1. Toothbrushing motivation

Short-term and long-term reasons for brushing: message framing

Many parents appear to be highly motivated by short-term factors when thinking about brushing their children's teeth, and this is an important consideration for considering the sorts of advice and messages given to parents about oral health. There is a tendency among practitioners and educators to focus on long-term outcomes when promoting the idea of regular toothbrushing: people should brush their teeth twice a day to avoid tooth decay and pain in the future. However, as Sanz and colleagues point out, it is clear that modern toothpastes "have both cosmetic and therapeutic objectives" (Sanz et al., 2013). The results of this project suggest that parents are equally interested (if not more interested) in the cosmetic effects of brushing. Oral health educators and practitioners should be conscious of this when considering the sorts of message that may be most persuasive for parents when encouraging them to brush their child's teeth more often.

In the wider health literature, much consideration has been given to the effect of message 'framing' on the effectiveness of health-promoting messages for different individuals. Research suggests, for example, that some individuals are more reactive to 'gain-framed' messages (emphasis on the positive effects of doing something), while others react better to 'loss-framed' messages (emphasis on the negative effects of not doing something) (Rothman et al., 2006). It may be that parents who focus on the short-term benefits of toothbrushing will be receptive to different types of oral health messages than those who focus on longer-term benefits. Further research is needed to understand whether there may be individual differences in receptiveness to different types of oral health message.

Morning and evening brushing

It was also the case that the same parents often had different reasons for brushing their child's teeth at different times of day. Given the importance of promoting twice-daily brushing, it may be important to acknowledge that morning and evening brushing are often considered to be separate events by parents. As a result, messages that promote regular morning brushing may not necessarily promote regular evening brushing, and vice versa.

The results also highlight the need for more data regarding when exactly parents brush their children's teeth. In previous studies where toothbrushing frequency has been measured, researchers have typically considered daily brushing frequency in categorical terms, by comparing those who brush 'once a day or less' with those who brush more, or by comparing those who brush at least once a day with those who brush less. Given that parents in Study 2 brushed their children's teeth more often in the morning than the evening, it would be interesting to see if this pattern is observed among other populations. More data about *when* parents brush their children's teeth is an important pre-requisite to designing more effective and relevant oral health advice or interventions.

7.4.2. Toothbrushing context

Toothbrushing and daily activities

The findings make clear that children's toothbrushing is often embedded in other daily activities and routines in the household, and this has implications for promoting regular toothbrushing. It is important for practitioners and oral health educators to consider the environmental or economic constraints under which parents operate when caring for their child's oral health in the home. Some of the parents interviewed in Study 1 had limited time with their children in the evening, for instance, due to work patterns or other commitments and consequently they struggled to establish a consistent habit of brushing their child's teeth twice a day. Recent research in Australia shows a higher

incidence of childhood caries among children whose mothers worked full-time in single-parent households, compared to children whose mothers worked full-time as part of a two-parent household or single-parent mothers who did not work full-time (Plutzer and Keirse, 2012). Such findings highlight the importance of considering the wider determinants of parents' decisions about brushing children's teeth, rather than focusing solely on their attitudes and beliefs.

As a result of parents' differing circumstances, it is likely that a 'one size fits all' approach to oral health advice will be flawed. Instead, practitioners and educators may need to spend time trying to understand each parent's specific circumstances, and tailor their advice accordingly. Indeed, it is possible that overly prescriptive advice about exactly when to brush child's teeth (for instance, before or after breakfast) may actually obstruct parents in developing a habit of brushing their child's teeth, or even disrupt existing habits. Encouraging parents to establish a habit by brushing their child's teeth after breakfast will, for instance, only be successful for families who have a reliable routine of eating breakfast each day.

Given the apparent influence of day-to-day routines on toothbrushing habit development, behaviour change interventions which account for a parent's home environment may be more successful than a more 'paternalistic' approach of telling parents what to do. Techniques such as 'motivational interviewing' (MI) attempt to gain an insight into a person's day-to-day life, before trying to integrate positive health behaviours into their existing daily routines. Findings from preliminary randomised controlled trials suggest that interventions in which parents receive MI-style counselling sessions containing advice on diet and oral hygiene may help in reducing the risk of children experiencing caries (Harrison et al., 2007, Weinstein et al., 2006), though more definitive work is needed in this area.

In contrast, psychosocial theories of behaviour such as the Theory of Planned Behaviour and the Health Belief Model have been criticised for failing to account for wider environmental circumstances. They may therefore have limited use in designing

interventions aimed at increasing the frequency of home toothbrushing in children. A systematic review by Yevlahova and Satur looked at articles evaluating the effectiveness of various health behaviour models in oral health, and concluded that methods such as Motivational Interviewing held the most promise for bringing about behaviour change (Yevlahova and Satur, 2009). They concluded that “addressing causes of oral disease in isolation from the clients’ life and social circumstances is ineffective in both the short and long term”.

Toothbrushing habits

‘Habits’ are often associated with behaviours which negatively affect health, such as unhealthy snacking, alcohol consumption and substance misuse. However, the same features which make habits so difficult to override in the case of problem behaviour – the fact that they are difficult to control, involve little conscious awareness and are performed regardless of short-term intentions – make habits very useful for establishing regular, health-promoting behaviours such as twice-daily toothbrushing. Previous studies looking at factors which might affect children’s oral hygiene in the home have highlighted factors such as poor maternal self-efficacy for brushing children’s teeth (an absence of confidence in mothers that they can regularly brush their child’s teeth), high levels of maternal anxiety and parental reports that children are ‘difficult’ and therefore reluctant to have their teeth brushed (Pine et al., 2004a, Pine et al., 2004b, Spitz et al., 2006, Seow et al., 2009). Some of the parents interviewed in Study 1 spoke of sometimes simply ‘forgetting’ to brush their child’s teeth on some days, and in the wider health literature, forgetting is one of the most commonly cited reasons for people not adhering to regularly taking medication (DiMatteo, 2004). The development of a parental habit for brushing children’s teeth may be one way to protect against each of these risk factors: habits effectively put a behaviour on ‘auto-pilot’ and so increases feelings of control and decreases the chance of forgetting. Indeed, Chapman and Ogden suggest that the benefits of developing a habit for performing certain actions

includes “cognitive economy; performance efficiency; low emotional engagement; low stress; and greater feelings of control” (Chapman and Ogden, 2009).

Habit theory may therefore provide a useful template for designing intervention aimed at changing parents’ long-term behaviour in terms of brushing their child’s teeth. Research exploring the way in which people develop health-beneficial habits in diet and exercise suggest that it can take as little as 18 days for a habit to develop, and that people are most susceptible to reverting back to old behavioural patterns during the first few weeks of an attempted change (Lally et al., 2011b, Lally and Gardner, 2011). This suggests that interventions designed to support parents developing a regular, twice-daily habit of brushing their child’s teeth would need to involve a front-loading of support in the initial few weeks, which could gradually be tapered off over time. Because the nature of habit formation means that behaviours eventually become automatically cued by external stimuli, habit-based interventions are particularly promising in terms of promoting sustainable, long-term changes to behaviour. Once a habit is established, it is likely to be maintained even when support is withdrawn, and despite changes in motivation or intentions.

McGowan and colleagues recently used habit theory to inform an exploratory randomised controlled-trial aimed at improving parents’ habits for giving their 2-6 year old children healthy snacks (McGowan et al., 2013). Parents in the intervention group received four visits from a coach over eight weeks, specifically aimed at developing their habit for giving their children more fruit and vegetables and healthy drinks (e.g., milk and water). At eight-week follow-up, parents in the intervention group reported a more automatic habit for giving their children healthy snacks, and children’s fruit, vegetable and water intake was significantly higher than in the control group. While more work is needed to understand the long-term benefits of habit-based interventions, the authors report that the intervention was well-received by parents.

Longitudinal studies of habit formation and development with regard to brushing children's teeth would be useful to highlight key stages at which support and intervention could be most effective for parents.

7.4.3. Toothbrushing norms

Social norms and social comparison

There is now a large body of research in the wider psychology and behavioural economics literature showing that people's judgements and behaviour can be affected by their perceptions of what other people do. Mussweiler describes social comparison – the act of comparing ourselves with others – as being “ubiquitous” and a “fundamental psychological mechanism influencing people's judgement, experiences and behaviour” (Mussweiler, 2003a). Indeed, there is growing recognition that understanding people's health-related behaviour requires consideration of a wider range of interpersonal, cultural and societal factors (Marmot, 2005, Marmot and Bell, 2011). Despite this, oral health advice and education has not yet capitalised on the potential to encourage behaviour change by sharing information about what people's peers do.

Current oral health education tends to focus on providing people with absolute, prescriptive advice (e.g., “you should brush your child's teeth twice a day”). However, the results presented in Study 1 and Study 2 suggest that such an approach may be limited. Firstly, the interviews in Study 1 suggest that parents only took the ‘twice a day’ advice seriously if they believed that it reflected the reality about what other parents actually did. For parents who thought their peers brushed less often, they didn't see this advice as being realistic or necessarily relevant to them. In Study 2, satisfaction was greater when parents believed that their child brushed more often than a perceived ‘average’ child, even when actual brushing frequency was controlled for. This suggests that parents' judgements about what constitutes an appropriate oral hygiene routine are to some extent relative (determined by social comparison), rather than absolute

(measured against objective standards). This is an important consideration, because parents who brush their own child's teeth less frequently than recommended may feel justified in their decisions if they perceive their behaviour to be 'normal', and so lack motivation to change. Improving parents' knowledge about how often to brush children's teeth may not encourage behaviour change if parents continue to believe that most other people don't adhere to such standards. The findings suggest that some parents may be more motivated to change their behaviour by messages which convey some element of social information (e.g., "most other parents in your area brush their children's teeth twice a day").

In the wider health literature, 'social normative interventions' have become increasingly prevalent in recent years. These interventions involve providing people with more accurate information about what their peers do, on the assumption that this will change their perceived norms and therefore their behaviour (Figure 7.4). A recent systematic review found that such interventions have led to improved outcomes with regard to alcohol and smoking in adolescent populations (Moreira et al., 2009). For toothbrushing behaviour, the interviews from Study 1 suggest that it is more likely that parents simply assume that other parents act similarly to themselves – that is, their behaviour informs their perceived norm, rather than vice versa. However, in either case, providing normative information to parents (e.g., "most other parents brush their child's teeth twice a day") should be an effective oral health education strategy. Whether parents' decisions are informed by, or inform their estimates of what others do, challenging misperceptions and utilising people's tendency to compare themselves with their peers should encourage parents to re-appraise their own behaviour.



Figure 7.4: Example of a 'social norms' based campaign aimed at school children, University of Salford

Range Frequency Theory

While social norms and social comparison theories highlight the importance of considering people's beliefs about what others do, they do not offer any suggestion about the specific cognitive mechanisms involved in relative judgements. Range Frequency Theory offers one account of how people's judgements and decisions may be affected by social and contextual information. The results from Study 3 showed that parents' judgements about different toothbrushing frequencies adhered to both the range and rank principles of Range Frequency Theory. The health merits of various toothbrushing routines were not judged by the frequency alone, but by how that frequency compared with how often a wider group of parents brush their child's teeth. The fact that these two principles appear to apply to oral health judgements is important, because it provides a theoretical basis from which to design advice and interventions aimed at parents who brush their children's teeth infrequently. The Medical Research Council stress that an important stage in the development of complex interventions is the identification and development of appropriate theory (Craig et al., 2008).

Range Frequency Theory suggests that messages will be effective if they encourage parents to believe that *most other* parents brush their children's teeth more often than they do (the rank principle) and that *some other* parents brush their children's teeth particularly often, such as 3 times per day or 21 times per week (the range principle). Again, these approaches, which incorporate information about what other people do,

should be more effective than the common approach of messages based on reinforcing absolute guidelines (e.g., “brush your child’s teeth twice a day”).

The results from Study 3 also showed that parents who were shown an example of a parent who brushed their child’s teeth 3 times a day (21 times per week) subsequently rated their own child’s brushing routine as significantly less healthy than parents who didn’t receive this information, despite the groups being well matched for brushing frequency. This suggests that parents’ satisfaction with their own child’s brushing routine is susceptible to being changed by presenting them with different information about what other parents do. Again, this information points to a potential pathway for increasing the frequency with which some parents brush their children’s teeth: by presenting information which shows that their peers brush their child’s teeth more often than they do, some parents will potentially become less satisfied with their own child’s brushing frequency and look for ways to improve it.

7.5. Recommendations

One of the limitations of chairside oral health advice or interventions delivered by dental practitioners is that not all parents and children from socio-economically deprived areas will regularly attend a dentist. For this reason, national school-based toothbrushing schemes like Childsmile and Designed to Smile may be able to reach a greater number of parents and children through their work in deprived communities. Whether through parent meetings, or materials sent home via children, these schemes provide a number of opportunities for communicating oral health messages to parents.

The recommendations made below are therefore equally applicable for practitioners or those working in an oral health education capacity.

7.5.1. Recommendations for practitioners, oral health educators

- Practitioners/educators should consider that, in addition to the long-term health benefits of brushing that are traditionally emphasised, many parents may be equally motivated to brush children's teeth by short-term, cosmetic factors.
- Practitioners/educators should consider that parents may have different reasons for brushing their child's teeth in the morning and the evening.
- Practitioners/educators should consider that, in addition to prescriptive advice ("you should do this"), messages based on what other parents do may be more persuasive for some parents. Such messages might emphasise that *most* parents brush their child's teeth twice a day (the rank principle), and that *some* parents brush their children's teeth even more often (the range principle).
- Practitioners/educators should try and encourage parents to develop an automatic *habit* of brushing their child's teeth twice a day, by recommending that parents brush their child's teeth before or after other consistently performed morning and evening routines.
- Practitioners/educators must take account of parents' wider social and economic circumstances when giving oral health advice, being mindful of the

way in which external constraints can bound parents' ability to implement a regular brushing routine for their child.

7.5.2. Recommendations for oral health researchers

Developing relevant theories and models of parents' decision making about brushing children's teeth is an important pre-requisite for designing behaviour change interventions. The results of this project suggest a number of concepts which appear to be relevant to understanding oral health decisions, but which are relatively novel to oral health research. The recommendations below suggest some areas which would benefit from further development.

- More information is needed about when parents brush children's teeth, as well as how often. Future surveys of children's toothbrushing frequency should collect data on morning and evening brushing separately, because of the potential that some children may have their teeth brushed more often at one time of day
- Research is needed to explore the extent to which parents who focus on short-term, cosmetic benefits of brushing a child's teeth may be receptive to different sorts of advice and messages than parents who focus more on the long-term benefits of toothbrushing.
- More research is needed to understand how parents form perceptions about how often other parents brush their child's teeth, and whether beliefs about more proximal peers (friends, family) exert more influence on parents' behaviour.
- It would be useful to examine whether parents from different socio-economic backgrounds have different perceptions of the 'norm' for how often to brush a child's teeth.

- More work is needed to explore the extent to which Range-Frequency Theory can predict the oral health judgements of parents from a range of different socio-economic backgrounds.
- Helping parents to develop an automatic ‘habit’ of brushing their child’s teeth may be an important goal of behaviour change interventions. Longitudinal studies of habit formation and development with regard to brushing children’s teeth would be useful to highlight key stages at which support and intervention could be most effective for parents.

The three themes explored in this thesis could also form the basis of future experimental studies or behaviour change interventions aimed at parents:

- **Toothbrushing norms:** The results relating to toothbrushing norms lend themselves to the development of ‘social normative interventions’ that have been developed in other health areas. These might, for instance, involve giving parents specific information about how often other parents in their area brush their children’s teeth, emphasising the idea that *most* parents brush their child’s teeth twice-a-day (appealing to the *rank* principle of Range Frequency Theory) and that *some* parents brush even more often (appealing to the *range* principle of Range Frequency Theory). The aim of such an intervention would be to encourage more frequent brushing through challenging some parents’ misperceptions that less frequent brushing was the ‘norm’.
- **Toothbrushing habits:** Interventions based on habit theory would seek to encourage parents to develop an automatic habit of brushing their child’s teeth in the morning and evening, with the aim of encouraging more frequent and consistent brushing. This would first require the identification of specific daily activities which occurred consistently in a parents’ daily routine, where the aim would be to integrate the action of brushing their child’s teeth immediately before or after a given action. Such interventions would likely require front-

loading of support, to encourage and support habit development during the initial weeks of habit development, with support eventually tapered off as the behaviour became automatic, and cued by environmental stimuli.

- **Toothbrushing motivation:** The individual differences in parents' rationale or motivation for brushing their child's teeth suggest that future studies may explore the extent to which specific 'gain-framed' or 'loss-framed' messages are more effective at encouraging parents to brush their children's teeth at different times of day.

7.6. Conclusions

This thesis presents the results of three studies, collectively aimed at understanding the decisions of parents from deprived communities regarding when and how often to brush their children's teeth at home. Young children are highly dependent on their parents for establishing good oral health practices at home, yet very little is understood about the factors that inform parents' decisions about how often and when to brush their child's teeth. As a consequence, oral health messages and advice aimed at parents may not currently be as effective as it could be, and there is an absence of theoretical frameworks to inform behaviour change interventions.

There is very strong evidence that brushing children's teeth twice a day with fluoride toothpaste will reduce their risk of developing dental caries. However, it is becoming increasingly clear that simply repeating best-practice advice to parents does not necessarily encourage long-term changes in behaviour. Instead, this project highlights the influence of factors such as a parent's motivation for brushing their child's teeth at different times of day, parents' perceived social norms for brushing, and the importance of day-to-day routines for parents in developing a habit of brushing their child's teeth. It also demonstrates that parents' judgements about what constitutes a healthy brushing routine are relative rather than absolute, and adhere to the principles of Range Frequency Theory. While many of these concepts have been explored in wider health fields, they have not yet been applied to understanding people's oral health decisions.

The results presented in the thesis have implications for re-thinking the type of advice and educational messages that practitioners and oral health educators provide to parents of young children. They suggest that educators and practitioners must acknowledge and account for the wider social and environmental conditions in which people live, and be aware of common cognitive biases in people's reasoning about health decisions.

The causes of dental caries in children are clearly multi-factorial. The undeniable social patterning of the disease means that focusing on individual-level, lifestyle determinants such as toothbrushing behaviour can sometimes be perceived as ‘victim blaming’. It is important to acknowledge that as a preventative strategy, oral health education - whether chairside, school-based or delivered at a wider level - is just one part of wider oral health promotion, which will necessarily involve ‘upstream’ strategies at economic, policy and legislative levels.

However, oral health education and advice will likely continue to play an important part of wider oral health promotion. Indeed, recent guidelines from the National Institute of Health and Care Excellence recommend that more oral health information should be incorporated in to general health services. They suggest that the advice should be integrated in to local health and wellbeing policies, that frontline health and social care staff should also deliver oral health advice, and that all ‘early years services’ should include information about oral health, including the importance of regular toothbrushing. The results of this project suggest that any such oral health information and advice will need to take account of people’s wider social and environmental conditions if it is to successfully promote long-term changes in people’s oral health behaviour.

The Medical Research Council stress that developing relevant theories is a crucial step in designing robust, complex interventions aimed at changing behaviour. However, interventions aimed at improving children’s oral health have often been criticised for lacking a theoretical basis, and Asimakopoulou and Newton recently reflected that “most work in oral health is either a-theoretical or relies on now dated attempts to use social cognition models to predict behaviour” (Asimakopoulou and Newton, 2015). The results of this project serve to demonstrate that habit theory and Range-Frequency Theory are both relevant for understanding how often parents brush their children’s teeth. The work therefore provides two concrete theoretical frameworks for developing future behaviour change interventions in oral health.

8. REFERENCES

- ACS, G., SHULMAN, R., NG, M. W. & CHUSSID, S. 1999. *The effect of dental rehabilitation on the body weight of children with early childhood caries. Pediatric Dentistry*, 21, 109-13.
- ADAIR, P. M., BURNSIDE, G. & PINE, C. M. 2013. *Analysis of health behaviour change interventions for preventing dental caries delivered in primary schools. Caries Research*, 47 Suppl 1, 2-12.
- ADAIR, P. M., PINE, C. M., BURNSIDE, G., NICOLL, A. D., GILLET, A., ANWAR, S., BROUKAL, Z., CHESTNUTT, I. G., DECLERCK, D., PING, F. X., FERRO, R., FREEMAN, R., GRANT-MILLS, D., GUGUSHE, T., HUNSRISAKHUN, J., IRIGOYEN-CAMACHO, M., LO, E. C., MOOLA, M. H., NAIDOO, S., NYANDINDI, U., POULSEN, V. J., RAMOS-GOMEZ, F., RAZANAMIHAJA, N., SHAHID, S., SKEIE, M. S., SKUR, O. P., SPLITTH, C., SOO, T. C., WHELTON, H. & YOUNG, D. W. 2004. *Familial and cultural perceptions and beliefs of oral hygiene and dietary practices among ethnically and socio-economically diverse groups. Community Dental Health*, 21, 102-11.
- AJZEN, I. 1985. *From intentions to actions: A theory of planned behavior*, In: Kuhl J. & Beckman J. (Eds.), *Action-control: From cognition to behavior*. Heidelberg: Springer, 11-39.
- AJZEN, I. 1991. *The theory of planned behavior. Organizational Behavior and Human Decision Processes*, 50, 179-211.
- ALLOM, V., MULLAN, B. & SEBASTIAN, J. 2013. *Closing the intention-behaviour gap for sunscreen use and sun protection behaviours. Psychology & Health*, 28, 477-494.
- ALM, A., WENDT, L. K., KOCH, G. & BIRKHED, D. 2008. *Oral hygiene and parent-related factors during early childhood in relation to approximal caries at 15 years of age. Caries Research*, 42, 28-36.
- AMAECHI, B. T. & VAN LOVEREN, C. 2013. *Fluorides and non-fluoride remineralization systems. Monographs in Oral Science*, 23, 15-26.
- AMERICAN ACADEMY OF PAEDIATRIC DENTISTRY. 2014. *Guideline on Fluoride Therapy [Online]*. Available: http://www.aapd.org/media/Policies_Guidelines/G_fluoridetherapy.pdf [Accessed January 2015].
- AMIN, M. S. & HARRISON, R. L. 2009. *Understanding parents' oral health behaviors for their young children. Qualitative Health Research*, 19, 116-27.
- ANTONOVSKY, A. 1993. *The structure and properties of the sense of coherence scale. Social Science & Medicine*, 36, 725-33.
- ARMFIELD, J. M., STEWART, J. F. & SPENCER, A. J. 2007. *The vicious cycle of dental fear: exploring the interplay between oral health, service utilization and dental fear. BMC Oral Health*, 7, 1.
- ARMITAGE, C. J. & CONNER, M. 2001. *Efficacy of the theory of planned behaviour: A meta-analytic review. British Journal of Social Psychology*, 40, 471-499.
- ARTHUR, R. M. 2011. *Examining traffic flow and speed data: determining imitative behavior. Traffic Injury Prevention*, 12, 266-73.

- ASIMAKOPOULOU K. & NEWTON J.T. 2015. *The contributions of behaviour change science towards dental public health practice: a new paradigm*. *Community Dentistry and Oral Epidemiology*, 43, 2-8.
- ÅSTR, A. N. & RISE, J. 2001. *Young adults' intention to eat healthy food: Extending the theory of planned behaviour*. *Psychology and Health*, 16, 223-237.
- ATKINS, D. C. & GALLOP, R. J. 2007. *Rethinking how family researchers model infrequent outcomes: a tutorial on count regression and zero-inflated models*. *Journal of Family Psychology*, 21, 726-35.
- AUNGER, R. 2007. *Tooth brushing as routine behaviour*. *International Dental Journal*, 57, 364-376.
- AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE. 2014. *Oral health and dental care in Australia. Key facts and figures trends 2014*. [Online]. Available: <http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129548452> [Accessed January 2015].
- AUSTRALIAN NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL. 2007. *A systematic review of the efficacy and safety of fluoridation*. [Online]. Available: https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh41_1.pdf [Accessed January 2015].
- BALL, K., JEFFERY, R. W., ABBOTT, G., MCNAUGHTON, S. A. & CRAWFORD, D. 2010. *Is healthy behavior contagious: associations of social norms with physical activity and healthy eating*. *International Journal of Behavioural Nutrition and Physical Activity*, 7, 86.
- BANDURA, A. 1977. *Social Learning Theory*, New York: General Learning Press.
- BANDURA, A. 2004. *Health promotion by social cognitive means*. *Health Education & Behavior*, 31, 143-164.
- BARGH, J. A. & CHARTRAND, T. L. 1999. *The unbearable automaticity of being*. *American Psychologist*, 54, 462.
- BERKOWITZ, R. J. 2003. *Causes, treatment and prevention of early childhood caries: a microbiologic perspective*. *The Journal of the Canadian Dental Association*, 69, 304-7.
- BERNABE, E. & HOBDELL, M. H. 2010. *Is income inequality related to childhood dental caries in rich countries?* *The Journal of the American Dental Association*, 141, 143-9.
- BERNABE, E., WATT, R. G., SHEIHAM, A., SUOMINEN-TAIPALE, A. L., NORDBLAD, A., SAVOLAINEN, J., KIVIMAKI, M. & TSAKOS, G. 2009. *The influence of sense of coherence on the relationship between childhood socioeconomic status and adult oral health-related behaviours*. *Community Dentistry and Oral Epidemiology*, 37, 357-65.
- BIRNBAUM, M. H., KOBERNICK, M. & VEIT, C. T. 1974. *Subjective correlation and the size-numerosity illusion*. *Journal of Experimental Psychology*, 102, 537-9.
- BIRNBAUM, M. H., PARDUCCI, A. & GIFFORD, R. K. 1971. *Contextual effects in information integration*. *Journal of Experimental Psychology*, 88, 158-70.
- BLECHERT, J., NICKERT, T., CAFFIER, D. & TUSCHEN-CAFFIER, B. 2009. *Social comparison and its relation to body dissatisfaction in bulimia nervosa: Evidence from eye movements*. *Psychosomatic Medicine*, 71, 907-912.

- BLINKHORN, A. S. 1978. *Influence of Social Norms on Toothbrushing Behavior of Preschool-Children. Community Dentistry and Oral Epidemiology*, 6, 222-226.
- BLINKHORN, A. S., WAINWRIGHT-STRINGER, Y. M. & HOLLOWAY, P. J. 2001. *Dental health knowledge and attitudes of regularly attending mothers of high-risk, pre-school children. International Dental Journal*, 51, 435-8.
- BONANATO, K., PAIVA, S. M., PORDEUS, I. A., RAMOS-JORGE, M. L., BARBABELA, D. & ALLISON, P. J. 2009. *Relationship between mothers' sense of coherence and oral health status of preschool children. Caries Research*, 43, 103-9.
- BORSARI, B. & CAREY, K. B. 2003. *Descriptive and injunctive norms in college drinking: A meta-analytic integration. Journal of Studies on Alcohol*, 64, 331.
- BOYCE, C. J., BROWN, G. D. & MOORE, S. C. 2010a. *Money and happiness: rank of income, not income, affects life satisfaction. Psychological Science*, 21, 471-5.
- BOYCE, W. T., DEN BESTEN, P. K., STAMPERDAHL, J., ZHAN, L., JIANG, Y., ADLER, N. E. & FEATHERSTONE, J. D. 2010b. *Social inequalities in childhood dental caries: the convergent roles of stress, bacteria and disadvantage. Social Science & Medicine*, 71, 1644-52.
- BRADFORD, W. D. 2010. *The association between individual time preferences and health maintenance habits. Medical Decision Making*, 30, 99-112.
- BRATTHALL, D., HANSEL-PETERSSON, G. & SUNDBERG, H. 1996. *Reasons for the caries decline: what do the experts believe? European Journal of Oral Sciences*, 104, 416-22; discussion 423-5, 430-2.
- BRAUN, V. & CLARKE, V. 2006. *Using thematic analysis in psychology. Qualitative Research in Psychology*, 3, 77-101.
- BRIDGMAN, C. M., ASHBY, D. & HOLLOWAY, P. J. 1999. *An investigation of the effects on children of tooth extraction under general anaesthesia in general dental practice. British Dental Journal*, 186, 245-7.
- BRITISH WATER FLUORIDATION SOCIETY. 2012. *One in a Million: the facts about water fluoridation. [Online]. Available: <http://www.bfsweb.org/onemillion/onemillion2012.html> [Accessed January 2015].*
- BROADBENT, J. M., PAGE, L. A., THOMSON, W. M. & POULTON, R. 2013. *Permanent dentition caries through the first half of life. British Dental Journal*, 215, E12.
- BROADBENT, J. M. & THOMSON, W. M. 2005. *For debate: problems with the DMF index pertinent to dental caries data analysis. Community Dentistry and Oral Epidemiology*, 33, 400-9.
- BROWN, G. D. A., GARDNER, J., OSWALD, A. J. & QIAN, J. 2008. *Does wage rank affect employees' well-being? Industrial Relations*, 47, 355-389.
- BROWN, L. F. 1994. *Research in dental health education and health promotion: a review of the literature. Health Education Quarterly*, 21, 83-102.
- BRUNO-AMBROSIUS, K., SWANHOLM, G. & TWETMAN, S. 2005. *Eating habits, smoking and toothbrushing in relation to dental caries: a 3-year study in Swedish female teenagers. International Journal of Paediatric Dentistry*, 15, 190-196.
- BRYMAN, A. 2006. *Integrating quantitative and qualitative research: how is it done? Qualitative Research*, 6, 97-113.

- BRYMAN, A. 2012. *Social Research Methods*. 4th ed. Oxford: Oxford University Press.
- BURT, B. A. 2002. Fluoridation and social equity. *Journal of Public Health Dentistry*, 62, 195-200.
- BURT, B. A. 2005. Concepts of risk in dental public health. *Community Dentistry and Oral Epidemiology*, 33, 240-7.
- BUUNK-WERKHOVEN, Y. A. B., DIJKSTRA, A. & VAN DER SCHANS, C. P. 2011. Determinants of oral hygiene behavior: a study based on the theory of planned behavior. *Community Dentistry and Oral Epidemiology*, 39, 250-259.
- BUUNK, A. P. & GIBBONS, F. X. 2007. Social comparison: The end of a theory and the emergence of a field. *Organizational Behavior and Human Decision Processes*, 102, 3-21.
- BUZALAF, M. A. & LEVY, S. M. 2011. Fluoride intake of children: considerations for dental caries and dental fluorosis. *Monographs in Oral Science*, 22, 1-19.
- BUZALAF, M. A., PESSAN, J. P., HONORIO, H. M. & TEN CATE, J. M. 2011. Mechanisms of action of fluoride for caries control. *Monographs in Oral Science*, 22, 97-114.
- CABINET OFFICE. 2008. *Social Exclusion Taskforce. Aspiration and attainment amongst young people in deprived communities: Analysis and discussion paper*. [Online]. Available: http://webarchive.nationalarchives.gov.uk/20090114000528/http://cabinetoffice.gov.uk/media/109339/aspirations_evidence_pack.pdf [Accessed January 2015].
- CAMERON, A. C. & TRIVEDI, P. K. 2013. *Regression Analysis of Count Data*. 2nd ed. Cambridge University Press.
- CASAMASSIMO, P. S., THIKKURISY, S., EDELSTEIN, B. L. & MAIORINI, E. 2009. Beyond the dmft: the human and economic cost of early childhood caries. *The Journal of the American Dental Association*, 140, 650-7.
- CHAPMAN, K. & OGDEN, J. 2009. How do people change their diet?: an exploration into mechanisms of dietary change. *Journal of Health Psychology*, 14, 1229-42.
- CHARMAZ, K. 2006. *Constructing grounded theory: A practical guide through qualitative research*. London: Sage.
- CHATZISARANTIS, N. L. D., HAGGER, M. S. & SMITH, B. 2007. Influences of perceived autonomy support on physical activity within the theory of planned behavior. *European Journal of Social Psychology*, 37, 934-954.
- CHEN, E. & MILLER, G. E. 2013. Socioeconomic status and health: Mediating and moderating factors. *Annual review of clinical psychology*, 9, 723-749.
- CHESTNUTT, I. G. 2013. Addressing oral health inequalities in the United Kingdom--the impact of devolution on population-based fluoride policy. *British Dental Journal*, 215, 11-2.
- CHESTNUTT, I. G., SCHAFER, F., JACOBSON, A. P. & STEPHEN, K. W. 1998. The influence of toothbrushing frequency and post-brushing rinsing on caries experience in a caries clinical trial. *Community Dentistry and Oral Epidemiology*, 26, 406-11.

- CIALDINI, R. B., RENO, R. R. & KALLGREN, C. A. 1990. A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of personality and social psychology*, 58, 1015.
- CLAYTON, D. A. & GRIFFITH, C. J. 2008. Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices. *International journal of environmental health research*, 18, 83-98.
- COHEN, J. 1973. Eta-Squared and Partial Eta-Squared in Fixed Factor ANOVA Designs. *Educational and Psychological Measurement*, 33, 107-112.
- COHEN, J. 1992. A power primer. *Psychological Bulletin*, 112, 155-9.
- COHEN, J., COHEN, P., WEST, S.G., AIKEN L.S. 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. Routledge.
- COOPER, A. M., O'MALLEY, L. A., ELISON, S. N., ARMSTRONG, R., BURNSIDE, G., ADAIR, P., DUGDILL, L. & PINE, C. 2013. Primary school-based behavioural interventions for preventing caries. *Cochrane Database of Systematic Reviews*, CD009378.
- CORTES, D. E., REATEGUI-SHARPE, L., SPIRO III, A. & GARCIA, R. I. 2012. Factors affecting children's oral health: perceptions among Latino parents. *Journal of Public Health Dentistry*, 72, 82-9.
- COXE, S., WEST, S. G. & AIKEN, L. S. 2009. The analysis of count data: a gentle introduction to Poisson regression and its alternatives. *Journal of Personality Assessment*, 91, 121-36.
- CRAIG, P., DIEPPE, P., MACINTYRE, S., MICHIE, S., NAZARETH, I., PETTICREW, M. & MEDICAL RESEARCH COUNCIL, G. 2008. Developing and evaluating complex interventions: the new Medical Research Council guidance. *British Medical Journal*, 337, a1655.
- CRESWELL, J. W. & MILLER, D. L. 2000. Determining validity in qualitative inquiry. *Theory into Practice*, 39, 124-130.
- CROUCHER, R. 1994. Lay perspectives on oral hygiene performance: their use in hypothesis development. *Community Dental Health*, 11, 105-10.
- CURNOW, M. M., PINE, C. M., BURNSIDE, G., NICHOLSON, J. A., CHESTERS, R. K. & HUNTINGTON, E. 2002. A randomised controlled trial of the efficacy of supervised toothbrushing in high-caries-risk children. *Caries Research*, 36, 294-300.
- DAHLGREN, G. & WHITEHEAD, M. 1991. *Policies and Strategies to Promote Social Equity in Health*. Stockholm: Institute for Future Studies.
- DALY, B., BATCHELOR, P., TREASURE, E. & WATT, R. 2013. *Essential Dental Public Health*. Oxford: Oxford University Press.
- DALY, B., CLARKE, W., MCEVOY, W., PERIAM, K. & ZOITPOULOS, L. 2010. Child oral health concerns amongst parents and primary care givers in a Sure Start Local Programme. *Community Dental Health*, 27, 167-171.
- DAUGHERTY, J. R. & BRASE, G. L. 2010. Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. *Personality and Individual Differences*, 48, 202-207.

- DAVIES, G. & BRIDGMAN, C. 2011. Improving oral health among schoolchildren - which approach is best? *British Dental Journal*, 210, 59-61.
- DAVIES, R. M., DAVIES, G. M. & ELLWOOD, R. P. 2003. Prevention. Part 4: Toothbrushing: what advice should be given to patients? *British Dental Journal*, 195, 135-41.
- DE BRUIJN, G. J. 2010. Understanding college students' fruit consumption. Integrating habit strength in the theory of planned behaviour. *Appetite*, 54, 16-22.
- DE SILVA-SANIGORSKI, A., ASHBOLT, R., GREEN, J., CALACHE, H., KEITH, B., RIGGS, E. & WATERS, E. 2013. Parental self-efficacy and oral health-related knowledge are associated with parent and child oral health behaviors and self-reported oral health status. *Community Dentistry and Oral Epidemiology*, 41, 345-52.
- DE VAUS, D. 2002. *Surveys in Social Research*. 5th ed. Routledge.
- DEAN, H. T. & MCKAY, F. S. 1939. Production of Mottled Enamel Halted by a Change in Common Water Supply. *American Journal of Public Health and the Nation's Health*, 29, 590-6.
- DECLERCK, D., LEROY, R., MARTENS, L., LESAFFRE, E., GARCIA-ZATTERA, M. J., VANDEN BROUCKE, S., DEBYSER, M. & HOPPENBROUWERS, K. 2008. Factors associated with prevalence and severity of caries experience in preschool children. *Community Dentistry and Oral Epidemiology*, 36, 168-78.
- DENZIN, N. K. & LINCOLN, Y. S. 2005. *The SAGE Handbook of Qualitative Research*. 3rd ed. Sage Publications.
- DEPARTMENT OF HEALTH. 2011. *Healthy Lives, Healthy People: Our strategy for public health in England* [Online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216096/dh_127424.pdf [Accessed January 2015].
- DESIGNED TO SMILE. 2014. *Designed to Smile web-site*. [Online]. Available: <http://www.designedtosmile.co.uk/home.html> [Accessed January 2015].
- DILLMAN, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. 3rd ed. John Wiley & Sons.
- DIMATTEO, M. R. 2004. Variations in Patients' Adherence to Medical Recommendations: A Quantitative Review of 50 Years of Research. *Medical Care*, 42, 200-209.
- DORRI, M., SHEIHAM, A. & WATT, R. G. 2009. Relationship between general hygiene behaviours and oral hygiene behaviours in Iranian adolescents. *European Journal of Oral Sciences*, 117, 407-12.
- DOUGLASS, J. M., TINANOFF, N., TANG, J. M. & ALTMAN, D. S. 2001. Dental caries patterns and oral health behaviors in Arizona infants and toddlers. *Community Dentistry and Oral Epidemiology*, 29, 14-22.
- DUCKWORTH, R. M., KNOOP, D. T. & STEPHEN, K. W. 1991. Effect of mouthrinsing after toothbrushing with a fluoride dentifrice on human salivary fluoride levels. *Caries Research*, 25, 287-91.
- DUNNING, D., HEATH, C. & SULS, J. M. 2004. Flawed Self-Assessment: Implications for Health, Education, and the Workplace. *Psychological Science in the Public Interest*, 5, 69-106.

DYE, B. A., NATIONAL CENTER FOR HEALTH STATISTICS (U.S.) & NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (U.S.) 2007. *Trends in oral health status: United States, 1988-1994 and 1999-2004*, Hyattsville, Md., U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

EDWARDS, P., ROBERTS, I., CLARKE, M., DIGUISEPPI, C., PRATAP, S., WENTZ, R. & KWAN, I. 2002. Increasing response rates to postal questionnaires: systematic review. *British Medical Journal*, 324, 1183.

ELFRINK, M. E., SCHULLER, A. A., VEERKAMP, J. S., POORTERMAN, J. H., MOLL, H. A. & TEN CATE, B. J. 2010. Factors increasing the caries risk of second primary molars in 5-year-old Dutch children. *International Journal of Paediatric Dentistry*, 20, 151-7.

ERIKSON, E. H. 1959. *Identity and the life cycle: Selected papers*. Psychological Issues, Monograph 1. New York: International Universities Press.

FAUL, F., ERDFELDER, E., LANG, A. G. & BUCHNER, A. 2007. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-91.

FEATHERSTONE, J. D. 1999. Prevention and reversal of dental caries: role of low level fluoride. *Community Dentistry and Oral Epidemiology*, 27, 31-40.

FEJERSKOV, O. & KIDD, E. 2008. *Dental caries: the disease and its clinical management*. 2nd ed. John Wiley & Sons.

FEJERSKOV, O., THYLSTRUP, A. & LARSEN, M. J. 1981. Rational use of fluorides in caries prevention. A concept based on possible cariostatic mechanisms. *Acta Odontologica Scandinavica*, 39, 241-9.

FESTINGER, L. 1954. A theory of social comparison processes. *Human Relations*, 7, 117-140.

FIGESE, B. H., HAMMONS, A. & GRIGSBY-TOUSSAINT, D. 2012. Family mealtimes: A contextual approach to understanding childhood obesity. *Economics and Human Biology*, 10, 365-374.

FIGESE, B. H., WAMBOLDT, F. S. & ANBAR, R. D. 2005. Family asthma management routines: Connections to medical adherence and quality of life. *The Journal of Pediatrics*, 146, 171-176.

FINLAYSON, T. L., SIEFERT, K., ISMAIL, A. I. & SOHN, W. 2007. Maternal self-efficacy and 1-5-year-old children's brushing habits. *Community Dentistry and Oral Epidemiology*, 35, 272-81.

FISHBEIN, M. & AJZEN, I. 1975. *Belief, attitude, intention, and behavior: an introduction to theory and research*. Reading, MA: Addison-Wesley.

FISHBEIN, M. & AJZEN, I. 2005. The influence of attitudes on behavior. In Albarracín D., Johnson B.T., & Zanna M.P. (Eds.), *The Handbook of Attitudes*. Mahwah, NJ: Erlbaum. pp173-221

FISHER-OWENS, S. A., GANSKY, S. A., PLATT, L. J., WEINTRAUB, J. A., SOOBADER, M. J., BRAMLETT, M. D. & NEWACHECK, P. W. 2007. Influences on children's oral health: A conceptual model. *Pediatrics*, 120, E510-E520.

- FISHER, R. J. & KATZ, J. E. 2000. Social-desirability bias and the validity of self-reported values. *Psychology & Marketing*, 17, 105-120.
- FOREMAN-PECK, J. & MOORE, S. C. 2010. Gratuitous violence and the rational offender model. *International Review of Law and Economics*, 30, 160-172.
- FORWARD, S. E. 2009. The theory of planned behaviour: The role of descriptive norms and past behaviour in the prediction of drivers' intentions to violate. *Transportation Research Part F: Traffic Psychology and Behaviour*, 12, 198-207.
- FREDERICK, S., LOEWENSTEIN, G. & O'DONOGHUE, T. 2002. Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40, 351-401.
- FREIRE, M. C., SHEIHAM, A. & HARDY, R. 2001. Adolescents' sense of coherence, oral health status, and oral health-related behaviours. *Community Dentistry and Oral Epidemiology*, 29, 204-12.
- GARDNER, B., DE BRUIJN, G. J. & LALLY, P. 2012. Habit, identity, and repetitive action: A prospective study of binge-drinking in UK students. *British Journal of Health Psychology*, 17, 565-581.
- GILL, P., STEWART, K., TREASURE, E., CHADWICK, B. Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*. 204. 291-295.
- GILL, P., STEWART, K., CHETCUTI, D. & CHESTNUTT, I. G. 2011. Children's understanding of and motivations for toothbrushing: a qualitative study. *International Journal of Dental Hygiene*, 9, 79-86.
- GILLHAM, B. 2000. *Developing a Questionnaire*. A&C Black.
- GLANZ, K., RIMER, B. K. & VISWANATH, K. 2008. *Health behavior and health education: theory, research, and practice*. 4th ed. John Wiley & Sons.
- GLASER, B. G. & STRAUSS, A. L. 1967. *The Discovery of Grounded Theory*. Chicago: Aldine.
- GOLDSTEIN, N. J., CIALDINI, R. B. & GRISKEVICIUS, V. 2008. A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, 35, 472-482.
- GREENING, L., STOPPELBEIN, L., KONISHI, C., JORDAN, S. S. & MOLL, G. 2007. Child routines and youths' adherence to treatment for type 1 diabetes. *Journal of Pediatric Psychology*, 32, 437-447.
- GUBRIUM, J. F. & HOLSTEIN, J. A. 2002. *Handbook of Interview Research: Context and Method*. SAGE Publications.
- HAINES, M. P., BARKER, G. P. & RICE, R. 2003. Using social norms to reduce alcohol and tobacco use in two midwestern high schools. *The Social Norms Approach to Preventing School and College Age Substance Abuse: A Handbook for Educators, Counselors, and Clinicians*. San Francisco, CA: Jossey-Bass, 235-244.
- HALE, L., BERGER, L. M., LEBOURGEOIS, M. K. & BROOKS-GUNN, J. 2009. Social and demographic predictors of preschoolers' bedtime routines. *Journal of Developmental and Behavioral Pediatrics*, 30, 394-402.
- HALL P.A. & FONG G.T., 2007. Temporal self-regulation theory: A model for individual health behaviour. *Health Psychology Review*, 1, 6-52.
- HAMMERSLEY, M. 1990. *Reading ethnographic research: A critical guide*. Longman.

- HANCOCK, L., ABHOLD, J., GASCOIGNE, J. & ALTEKRUSE, M. 2002. *Applying social norms marketing to tobacco cessation and prevention: lessons learned from three campaigns. The Report on Social Norms: Working Paper #6.* Little Falls, NJ: Paper-Clip Communications.
- HARRIS, P., SPARKS, P. & RAATS, M. 2002. *Theoretical and applied issues in the provision of absolute and comparative risk information.* *Risk, Decision and Policy*, 7, 153-163.
- HARRIS, R., NICOLL, A. D., ADAIR, P. M. & PINE, C. M. 2004. *Risk factors for dental caries in young children: a systematic review of the literature.* *Community Dental Health*, 21, 71-85.
- HARRISON, R., BENTON, T., EVERSON-STEWART, S. & WEINSTEIN, P. 2007. *Effect of motivational interviewing on rates of early childhood caries: a randomized trial.* *Pediatric Dentistry*, 29, 16-22.
- HENNINK, M., HUTTER, I. & BAILEY, A. 2010. *Qualitative Research Methods.* SAGE Publications.
- HODGE, H. C., HOLLOWAY, P. J. & BELL, C. R. 1983. *Factors associated with toothbrushing behaviour in adolescents.* *Dental health*, 22, 7-9.
- HOOLEY, M., SKOUTERIS, H., BOGANIN, C., SATUR, J. & KILPATRICK, N. 2012a. *Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011.* *Systematic Reviews*, 1, 57.
- HOOLEY, M., SKOUTERIS, H., BOGANIN, C., SATUR, J. & KILPATRICK, N. 2012b. *Parental influence and the development of dental caries in children aged 0-6 years: a systematic review of the literature.* *Journal of Dentistry*, 40, 873-85.
- HORNE, R., WEINMAN, J., BARBER, N., ELLIOTT, R., MORGAN, M. & CRIBB, A. 2005. *Concordance, adherence and compliance in medicine taking.* London: NCCSDO, 40-46.
- HOSEY, M. T., MACPHERSON, L. M., ADAIR, P., TOCHEL, C., BURNSIDE, G. & PINE, C. 2006. *Dental anxiety, distress at induction and postoperative morbidity in children undergoing tooth extraction using general anaesthesia.* *British Dental Journal*, 200, 39-43.
- HUEBNER, C. E. & RIEDY, C. A. 2010. *Behavioral determinants of brushing young children's teeth: implications for anticipatory guidance.* *Pediatric Dentistry*, 32, 48-55.
- HUTCHINSON, M. K. & HOLTMAN, M. C. 2005. *Analysis of count data using Poisson Regression.* *Research in Nursing & Health*, 28, 408-18.
- IBM 2011. *IBM SPSS Statistics for Windows, Version 20.0,* Armonk, NY: IBM Corp.
- INNES, N. P., CLARKSON, J. E., SPEED, C., DOUGLAS, G. V. & MAGUIRE, A. 2013. *The FICTION dental trial protocol - filling children's teeth: indicated or not?* *BMC Oral Health*, 13, 25.
- INNES, N. P. & EVANS, D. J. 2013. *Modern approaches to caries management of the primary dentition.* *British Dental Journal*, 214, 559-66.
- JACKSON, R. J., NEWMAN, H. N., SMART, G. J., STOKES, E., HOGAN, J. I., BROWN, C. & SERES, J. 2005. *The effects of a supervised toothbrushing programme on the caries increment of primary school children, initially aged 5-6 years.* *Caries Research*, 39, 108-15.

- JENSEN, E. W., JAMES, S. A., BOYCE, W. T. & HARTNETT, S. A. 1983. *The family routines inventory: development and validation*. *Social Science & Medicine*, 17, 201-11.
- JOHNSON, R.B. & ONWUEGBUZIE, A. 2004. *Mixed Methods Research: A Research Paradigm Whose Time Has Come*. *Educational Researcher*, 33, 14-26.
- JOINSON, A. N. 2001. *Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity*. *European Journal of Social Psychology*, 31, 177-192.
- JONES, D. C. 2001. *Social comparison and body image: Attractiveness comparisons to models and peers among adolescent girls and boys*. *Sex Roles*, 45, 645-664.
- KAHNEMAN, D. 2003. *A perspective on judgment and choice: mapping bounded rationality*. *American Psychologist*, 58, 697-720.
- KAY, E. & LOCKER, D. 1998. *A systematic review of the effectiveness of health promotion aimed at improving oral health*. *Community Dental Health*, 15, 132-44.
- KAY, E. J. & LOCKER, D. 1996. *Is dental health education effective? A systematic review of current evidence*. *Community Dentistry and Oral Epidemiology*, 24, 231-5.
- KING, N. & HORROCKS, C. 2010. *Interviews in Qualitative Research*, SAGE Publications.
- KIRBY, K. N. 2009. *One-year temporal stability of delay-discount rates*. *Psychonomic Bulletin & Review*, 16, 457-62.
- KIRBY, K. N. & MARAKOVIC, N. N. 1996. *Delay-discounting probabilistic rewards: Rates decrease as amounts increase*. *Psychonomic Bulletin & Review*, 3, 100-104.
- KIRK, J. & MILLER, M. L. 1986. *Reliability and Validity in Qualitative Research*, SAGE Publications.
- KITTS, J. A. 2003. *Egocentric bias or information management? Selective disclosure and the social roots of norm misperception*. *Social Psychology Quarterly*, 222-237.
- KLEIN, W. M. 1997. *Objective standards are not enough: affective, self-evaluative, and behavioral responses to social comparison information*. *Journal of Personality and Social Psychology*, 72, 763-74.
- KOHLER, B., BRATTHALL, D. & KRASSE, B. 1983. *Preventive measures in mothers influence the establishment of the bacterium Streptococcus mutans in their infants*. *Archives of Oral Biology*, 28, 225-31.
- KYPRI, K. & LANGLEY, J. D. 2003. *Perceived social norms and their relation to university student drinking*. *Journal of Studies on Alcohol and Drugs*, 64, 829.
- LABIG JR, C. E., ZANTOW, K. & PETERSON, T. O. 2005. *Factors affecting students' medicine-taking habits*. *Journal of American College Health*, 54, 177-183.
- LABRIE, J. W., HUMMER, J. F., NEIGHBORS, C. & LARIMER, M. E. 2010. *Whose opinion matters? The relationship between injunctive norms and alcohol consequences in college students*. *Addictive Behaviors*, 35, 343-349.
- LALLY, P., BARTLE, N. & WARDLE, J. 2011a. *Social norms and diet in adolescents*. *Appetite*, 57, 623-627.
- LALLY, P., WARDLE, J. & GARDNER, B. 2011b. *Experiences of habit formation: A qualitative study*. *Psychology Health & Medicine*, 16, 484-489.

- LALLY, P. & GARDNER, B. 2011. Promoting habit formation. *Health Psychology Review*, 7, S137-S158.
- LALLY, P., COOKE, L., MCGOWAN, L., CROKER, H., BARTLE, N. & WARDLE, J. 2012. Parents' misperceptions of social norms for pre-school children's snacking behaviour. *Public Health Nutrition*, 1, 1-5.
- LARIMER, M. E., TURNER, A. P., MALLETT, K. A. & GEISNER, I. M. 2004. Predicting drinking behavior and alcohol-related problems among fraternity and sorority members: examining the role of descriptive and injunctive norms. *Psychology of Addictive Behaviors*, 18, 203.
- LENCOVA, E., PIKHART, H., BROUKAL, Z. & TSAKOS, G. 2008. Relationship between parental locus of control and caries experience in preschool children - cross-sectional survey. *BMC Public Health*, 8, 208.
- LEVIN, K. A. & CURRIE, C. 2010. Adolescent toothbrushing and the home environment: sociodemographic factors, family relationships and mealtime routines and disorganisation. *Community Dentistry and Oral Epidemiology*, 38, 10-8.
- LINCOLN, Y. S. & GUBA, E. G. 1985. *Naturalistic Inquiry*, London: SAGE Publications.
- LISTL, S. 2011. Family composition and children's dental health behavior: evidence from Germany. *Journal of Public Health Dentistry*, 71, 91-101.
- LUOTO, A., TOLVANEN, M., RANTAVUORI, K., POHJOLA, V. & LAHTI, S. 2010. Can parents and children evaluate each other's dental fear? *European Journal of Oral Sciences*, 118, 254-8.
- MACGREGOR, I. D., BALDING, J. & REGIS, D. 1996. Toothbrushing schedule, motivation and 'lifestyle' behaviours in 7,770 young adolescents. *Community Dental Health*, 13, 232-7.
- MACGREGOR, I. D. M. & BALDING, J. W. 1991. Self-esteem as a predictor of toothbrushing behaviour in young adolescents. *Journal of Clinical Periodontology*, 18, 312-316.
- MACPHERSON, L. M., ANOPA, Y., CONWAY, D. I. & MCMAHON, A. D. 2013. National supervised toothbrushing program and dental decay in Scotland. *Journal of Dental Research*, 92, 109-13.
- MACPHERSON, L. M., BALL, G. E., BREWSTER, L., DUANE, B., HODGES, C. L., WRIGHT, W., GNICH, W., RODGERS, J., MCCALL, D. R., TURNER, S. & CONWAY, D. I. 2010. Childsmile: the national child oral health improvement programme in Scotland. Part 1: Establishment and development. *British Dental Journal*, 209, 73-8.
- MALTBY, J., WOOD, A. M., VLAEV, I., TAYLOR, M. J. & BROWN, G. D. A. 2012. Contextual Effects on the Perceived Health Benefits of Exercise: The Exercise Rank Hypothesis. *Journal of Sport & Exercise Psychology*, 34, 828-841.
- MARINHO, V. C., HIGGINS, J. P., LOGAN, S. & SHEIHAM, A. 2003a. Fluoride mouthrinses for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, CD002284.
- MARINHO, V. C., HIGGINS, J. P., LOGAN, S. & SHEIHAM, A. 2003b. Systematic review of controlled trials on the effectiveness of fluoride gels for the prevention of dental caries in children. *Journal of Dental Education*, 67, 448-58.

- MARINHO, V. C., HIGGINS, J. P., SHEIHAM, A. & LOGAN, S. 2003c. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, CD002278.
- MARINHO, V. C., HIGGINS, J. P., SHEIHAM, A. & LOGAN, S. 2004a. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, CD002781.
- MARINHO, V. C., HIGGINS, J. P., SHEIHAM, A. & LOGAN, S. 2004b. One topical fluoride (toothpastes, or mouthrinses, or gels, or varnishes) versus another for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, CD002780.
- MARINHO, V. C., WORTHINGTON, H. V., WALSH, T. & CLARKSON, J. E. 2013. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, 7, CD002279.
- MARMOT, M. 2005. Social determinants of health inequalities. *Lancet*, 365, 1099-104.
- MARMOT, M. & BELL, R. 2011. Social determinants and dental health. *Advances in Dental Research*, 23, 201-6.
- MARMOT, M. & WILKINSON, R. 2005. *Social Determinants of Health*. Oxford: Oxford University Press.
- MARSHALL, T. A., EICHENBERGER-GILMORE, J. M., BROFFITT, B. A., WARREN, J. J. & LEVY, S. M. 2007. Dental caries and childhood obesity: roles of diet and socioeconomic status. *Community Dentistry and Oral Epidemiology*, 35, 449-58.
- MARTENS, L., VANOBBERGEN, J., LEROY, R., LESAFFRE, E. & DECLERCK, D. 2004. Variables associated with oral hygiene levels in 7-year-olds in Belgium. *Community Dental Health*, 21, 4-10.
- MARTHALER, T. M. 2004. Changes in dental caries 1953-2003. *Caries Research*, 38, 173-181.
- MARTINS-JUNIOR, P. A., VIEIRA-ANDRADE, R. G., CORREA-FARIA, P., OLIVEIRA-FERREIRA, F., MARQUES, L. S. & RAMOS-JORGE, M. L. 2013. Impact of early childhood caries on the oral health-related quality of life of preschool children and their parents. *Caries Research*, 47, 211-8.
- MASON, J. 2002. *Qualitative Researching*, 2nd ed. SAGE Publications.
- MASOOD, M., THALIATH, E. T., BOWER, E. J. & NEWTON, J. T. 2011. An appraisal of the quality of published qualitative dental research. *Community Dentistry and Oral Epidemiology*, 39, 193-203.
- MATTILA, M. L., RAUTAVA, P., SILLANPAA, M. & PAUNIO, P. 2000. Caries in five-year-old children and associations with family-related factors. *Journal of Dental Research*, 79, 875-81.
- MAXIMOVA, K., MCGRATH, J. J., BARNETT, T., O'LOUGHLIN, J., PARADIS, G. & LAMBERT, M. 2008. Do you see what I see? Weight status misperception and exposure to obesity among children and adolescents. *International Journal of Obesity*, 32, 1008-1015.

- MCALANEY, J. & MCMAHON, J. 2007. Normative beliefs, misperceptions, and heavy episodic drinking in a British student sample. *Journal of Studies on Alcohol and Drugs*, 68, 385.
- MCARTHUR, D., DUMAS, A., WOODEND, K., BEACH, S. & STACEY, D. 2014. Factors influencing adherence to regular exercise in middle-aged women: a qualitative study to inform clinical practice. *BMC women's health*, 14, 49.
- MCDONAGH, M. S., WHITING, P. F., WILSON, P. M., SUTTON, A. J., CHESTNUTT, I., COOPER, J., MISSO, K., BRADLEY, M., TREASURE, E. & KLEIJNEN, J. 2000. Systematic review of water fluoridation. *British Medical Journal*, 321, 855-9.
- MCGOWAN, L., COOKE, L. J., GARDNER, B., BEEKEN, R. J., CROKER, H. & WARDLE, J. 2013. Healthy feeding habits: efficacy results from a cluster-randomized, controlled exploratory trial of a novel, habit-based intervention with parents. *The American Journal of Clinical Nutrition*, 98, 769-77.
- MCMAHON, A. D., BLAIR, Y., MCCALL, D. R. & MACPHERSON, L. M. 2010. The dental health of three-year-old children in Greater Glasgow, Scotland. *British Dental Journal*, 209, E5.
- MELANKO, S. & LARKIN, K. T. 2013. Preference for immediate reinforcement over delayed reinforcement: relation between delay discounting and health behavior. *Journal of Behavioral Medicine*, 36, 34-43.
- MERCKEN, L., CANDEL, M., VAN OSCH, L. & DE VRIES, H. 2011. No smoke without fire: The impact of future friends on adolescent smoking behaviour. *British Journal of Health Psychology*, 16, 170-88.
- MILEY, W. M. & FRANK, M. 2006. Binge and non-binge college students' perceptions of other students' drinking habits. *College Student Journal*, 40, 259-262.
- MILSOM, K. M., TICKLE, M. & BLINKHORN, A. S. 2002. Dental pain and dental treatment of young children attending the general dental service. *British Dental Journal*, 192, 280-4.
- MOHEBBI, S. Z., VIRTANEN, J. I., MURTOMAA, H., VAHID-GOLPAYEGANI, M. & VEHKALAHTI, M. M. 2008. Mothers as facilitators of oral hygiene in early childhood. *International Journal of Paediatric Dentistry*, 18, 48-55.
- MOLES, D. R. & ASHLEY, P. 2009. Hospital admissions for dental care in children: England 1997-2006. *British Dental Journal*, 206, E14; discussion 378-9.
- MOREIRA, M. T., SMITH, L. A. & FOXCROFT, D. 2009. Social norms interventions to reduce alcohol misuse in university or college students. *Cochrane Database Systematic Review*, CD006748.
- MOYNIHAN, P. J. & KELLY, S. A. 2014. Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines. *Journal of Dental Research*, 93, 8-18.
- MUSSWEILER, T. 2003a. Comparison processes in social judgment: mechanisms and consequences. *Psychological Review*, 110, 472-89.
- MUSSWEILER, T. 2003b. 'Everything is relative': Comparison processes in social judgement. The 2002 Jaspars Lecture. *European Journal of Social Psychology*, 33, 719-733.

- MYERS, T. A. & CROWTHER, J. H. 2009. Social Comparison as a Predictor of Body Dissatisfaction: A Meta-Analytic Review. *Journal of Abnormal Psychology*, 118, 683-698.
- NEAL, D. T., WOOD, W. & QUINN, J. M. 2006. Habits - A repeat performance. *Current Directions in Psychological Science*, 15, 198-202.
- NEW ZEALAND MINISTRY OF HEALTH. 2010. Our Oral Health. Key findings of the 2009 New Zealand Oral Health Survey. [Online]. Available: <http://www.health.govt.nz/system/files/documents/publications/our-oral-health-2010.pdf> [Accessed January 2015].
- NEWTON, J. T. & BOWER, E. J. 2005. The social determinants of oral health: new approaches to conceptualizing and researching complex causal networks. *Community Dentistry and Oral Epidemiology*, 33, 25-34.
- NICOLAU, B., THOMSON, W. M., STEELE, J. G. & ALLISON, P. J. 2007. Life-course epidemiology: concepts and theoretical models and its relevance to chronic oral conditions. *Community Dentistry and Oral Epidemiology*, 35, 241-9.
- NOAR, S. M. 2013. Letter to the editor: Charting the course forward: promising trends in health behavior theory application. *Journal of Public Health Dentistry*, 73, 83-5.
- NURMI, J. E. 1987. Age, sex, social class, and quality of family interaction as determinants of adolescents' future orientation: a developmental task interpretation. *Adolescence*, 22, 977-91.
- OGDEN, J. 2003. Some problems with social cognition models: a pragmatic and conceptual analysis. *Health Psychology*, 22, 424-8.
- OGDEN, J. 2007. *Health Psychology: A Textbook*. 4th ed. McGraw-Hill Education.
- OPDENAKKER, R. 2006. *Advantages and Disadvantages of Four Interview Techniques in Qualitative Research*.
- ORBELL, S. & VERPLANKEN, B. 2010. The automatic component of habit in health behavior: habit as cue-contingent automaticity. *Health Psychology*, 29, 374-83.
- OUELLETTE, J. A. & WOOD, W. 1998. Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological Bulletin*, 124, 54.
- PAHEL, B. T., ROZIER, R. G. & SLADE, G. D. 2007. Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). *Health and Quality of Life Outcomes*, 5, 6.
- PARDUCCI, A. 1965. Category judgment: a range-frequency model. *Psychological Review*, 72, 407-18.
- PARDUCCI, A. & MARSHALL, L. M. 1961. Context-effects in judgements of length. *American Journal of Psychology*, 74, 576-83.
- PARISOTTO, T. M., STEINER-OLIVEIRA, C., SILVA, C. M., RODRIGUES, L. K. & NOBRE-DOS-SANTOS, M. 2010. Early childhood caries and mutans streptococci: a systematic review. *Oral Health & Preventive Dentistry*, 8, 59-70.
- PARNELL, C. & O'MULLANE, D. 2013. After-brush rinsing protocols, frequency of toothpaste use: fluoride and other active ingredients. *Monographs in Oral Science*, 23, 140-53.

PATTON, M. Q. 1990. *Qualitative Evaluation and Research Methods*, SAGE Publications.

PERES, M. A., BARROS, A. J., PERES, K. G., ARAUJO, C. L. & MENEZES, A. M. 2009. Life course dental caries determinants and predictors in children aged 12 years: a population-based birth cohort. *Community Dentistry and Oral Epidemiology*, 37, 123-33.

PERES, M. A., DE OLIVEIRA LATORRE MDO, R., SHEIHAM, A., PERES, K. G., BARROS, F. C., HERNANDEZ, P. G., MAAS, A. M., ROMANO, A. R. & VICTORA, C. G. 2005. Social and biological early life influences on severity of dental caries in children aged 6 years. *Community Dentistry and Oral Epidemiology*, 33, 53-63.

PERKINS, H. 2002a. Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol and Drugs*, 164.

PERKINS, H. 2002b. Surveying the damage: a review of research on consequences of alcohol misuse in college populations. *Journal of Studies on Alcohol Suppl*, 91-100.

PERKINS, H. 2003. *The social norms approach to preventing school and college age substance abuse: A handbook for educators, counselors, and clinicians*, Jossey-Bass.

PERKINS, H., HAINES, M. P. & RICE, R. 2005. Misperceiving the college drinking norm and related problems: A nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *Journal of Studies on Alcohol and Drugs*, 66, 470.

PERKINS, H. W. & CRAIG, D. W. 2003. The imaginary lives of peers: Patterns of substance use and misperceptions of norms among secondary school students. *The Social Norms Approach to Preventing School and College Age Substance Abuse: A Handbook for Educators, Counselors, and Clinicians*. San Francisco, CA: Jossey-Bass, 209-23.

PETERSEN, P. E. 2009. Global policy for improvement of oral health in the 21st century--implications to oral health research of World Health Assembly 2007, World Health Organization. *Community Dentistry and Oral Epidemiology*, 37, 1-8.

PETERSEN, P. E., BOURGEOIS, D., OGAWA, H., ESTUPINAN-DAY, S. & NDIAYE, C. 2005. The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, 83, 661-9.

PETERSEN, P. E., HOERUP, N., POOMVISET, N., PROMMAJAN, J. & WATANAPA, A. 2001. Oral health status and oral health behaviour of urban and rural schoolchildren in Southern Thailand. *International Dental Journal*, 51, 95-102.

PETERSEN, P. E. & LENNON, M. A. 2004. Effective use of fluorides for the prevention of dental caries in the 21st century: the WHO approach. *Community Dentistry and Oral Epidemiology*, 32, 319-21.

PINE, C. M., ADAIR, P. M., NICOLL, A. D., BURNSIDE, G., PETERSEN, P. E., BEIGHTON, D., GILLET, A., ANDERSON, R., ANWAR, S., BRAILSFORD, S., BROUKAL, Z., CHESTNUTT, I. G., DECLERCK, D., PING, F. X., FERRO, R., FREEMAN, R., GUGUSHE, T., HARRIS, R., LIN, B., LO, E. C., MAUPOME, G., MOOLA, M. H., NAIDOO, S., RAMOS-GOMEZ, F., SAMARANAYAKE, L. P., SHAHID, S., SKEIE, M. S., SPLIETH, C., SUTTON, B. K., SOO, T. C. & WHELTON, H. 2004a. International comparisons of health inequalities in childhood dental caries. *Community Dental Health*, 21, 121-30.

- PINE, C. M., ADAIR, P. M., PETERSEN, P. E., DOUGLASS, C., BURNSIDE, G., NICOLL, A. D., GILLET, A., ANDERSON, R., BEIGHTON, D., JIN-YOU, B., BROUKAL, Z., BROWN, J. P., CHESTNUTT, I. G., DECLERCK, D., DEVINE, D., ESPELID, I., FALCOLINI, G., PING, F. X., FREEMAN, R., GIBBONS, D., GUGUSHE, T., HARRIS, R., KIRKHAM, J., LO, E. C., MARSH, P., MAUPOME, G., NAIDOO, S., RAMOS-GOMEZ, F., SUTTON, B. K. & WILLIAMS, S. 2004b. Developing explanatory models of health inequalities in childhood dental caries. *Community Dental Health*, 21, 86-95.
- PINE, C. M., HARRIS, R. V., BURNSIDE, G. & MERRETT, M. C. 2006. An investigation of the relationship between untreated decayed teeth and dental sepsis in 5-year-old children. *British Dental Journal*, 200, 45-7; discussion 29.
- PITTS, N. 2004. "ICDAS"--an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. *Community Dental Health*, 21, 193-8.
- PITTS, N. B., BOYLES, J., NUGENT, Z. J., THOMAS, N. & PINE, C. M. 2007. The dental caries experience of 5-year-old children in Great Britain (2005/6). Surveys co-ordinated by the British Association for the study of community dentistry. *Community Dental Health*, 24, 59-63.
- PLUTZER, K. & KEIRSE, M. J. 2012. Influence of first-time mothers' early employment on severe early childhood caries in their child. *International Journal of Pediatrics*, 2012.
- POLK, D.E., GENG, M., LEVY, S., KOERBER A., FLAY B.R. 2014. Frequency of daily tooth brushing: predictors of change in 9- to 11-year old US children. *Community Dental Health*, 31, 136-140.
- POPE, C. & MAYS, N. 2013. *Qualitative Research in Health Care*. 3rd ed. Wiley.
- PORRITT, J., BUCHANAN, H., HALL, M., GILCHRIST, F. & MARSHMAN, Z. 2013. Assessing children's dental anxiety: a systematic review of current measures. *Community Dentistry and Oral Epidemiology*, 41, 130-42.
- POUTANEN, R., LAHTI, S., SEPPA, L., TOLVANEN, M. & HAUSEN, H. 2007. Oral health-related knowledge, attitudes, behavior, and family characteristics among Finnish schoolchildren with and without active initial caries lesions. *Acta Odontologica Scandinavica*, 65, 87-96.
- POVEY, R., CONNER, M., SPARKS, P., JAMES, R. & SHEPHERD, R. 2000. Application of the Theory of Planned Behaviour to two dietary behaviours: Roles of perceived control and self-efficacy. *British Journal of Health Psychology*, 5, 121-139.
- PUBLIC HEALTH ENGLAND. 2013. National Dental Epidemiology Programme for England: oral health survey of five-year-old children 2012. A report on the prevalence and severity of dental decay. [Online]. Available: <http://www.nwph.net/dentalhealth/Oral%20Health%205yr%20old%20children%202012%20final%20report%20gateway%20approved.pdf> [Accessed January 2015].
- PUBLIC HEALTH ENGLAND. 2014. Delivering better oral health: an evidence-based toolkit for prevention. Third edition. [Online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/367563/DBOHv32014OCTMainDocument_3.pdf [Accessed January 2015].
- RAADAL, M., STRAND, G. V., AMARANTE, E. C. & KVALE, G. 2002. Relationship between caries prevalence at 5 years of age and dental anxiety at 10. *European Journal of Paediatric Dentistry*, 3, 22-6.

- RAJALA, M., HONKALA, E., RIMPELA, M. & LAMMI, S. 1980. Toothbrushing in relation to other health habits in Finland. *Community Dentistry and Oral Epidemiology*, 8, 391-5.
- REISINE, S. T. & PSOTER, W. 2001. Socioeconomic status and selected behavioral determinants as risk factors for dental caries. *Journal of Dental Education*, 65, 1009-16.
- REYNOLDS, B. 2006. A review of delay-discounting research with humans: relations to drug use and gambling. *Behavioural Pharmacology*, 17, 651-67.
- RHODES, R. E. & DICKAU, L. 2012. Experimental evidence for the intention-behavior relationship in the physical activity domain: a meta-analysis. *Health Psychology*, 31, 724-7.
- RIVIS, A. & SHEERAN, P. 2003. Descriptive norms as an additional predictor in the theory of planned behaviour: A meta-analysis. *Current Psychology*, 22, 218-233.
- RIVIS, A., SHEERAN, P. & ARMITAGE, C. J. 2006. Augmenting the theory of planned behaviour with the prototype/willingness model: Predictive validity of actor versus abstainer prototypes for adolescents' health-protective and health-risk intentions. *British Journal of Health Psychology*, 11, 483-500.
- RODRIGUES, C. S. & SHEIHAM, A. 2000. The relationships between dietary guidelines, sugar intake and caries in primary teeth in low income Brazilian 3-year-olds: a longitudinal study. *International Journal of Paediatric Dentistry*, 10, 47-55.
- ROSE, G. 1985. Sick Individuals and Sick Populations. *International Journal of Epidemiology*, 14, 32-38.
- ROSE, G. 1993. Preventive strategy and general practice. *British Journal of General Practice*, 43, 138-9.
- ROSENSTOCK, I. M. 1974. Historical Origins of the Health Belief Model. *Health Education & Behavior*, 2, 328-335.
- ROSS, L., GREENE, D. & HOUSE, P. 1977. The "false consensus effect": An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology*, 13, 279-301.
- ROTHMAN, A. J., BARTELS, R. D., WLASCHIN, J. & SALOVEY, P. 2006. The Strategic Use of Gain-and Loss-Framed Messages to Promote Healthy Behavior: How Theory Can Inform Practice. *Journal of Communication*, 56, S202-S220.
- RYAN, G. W. & WAGNER, G. J. 2003. Pill taking 'routinization': a critical factor to understanding episodic medication adherence. *AIDS Care*, 15, 795-806.
- SABATE, E. 2003. Adherence to long-term therapies: Evidence for action. World Health Organization. [online] Available: <http://whqlibdoc.who.int/publications/2003/9241545992.pdf> [Accessed January 2015]
- SAIED-MOALLEMI, Z., VIRTANEN, J. I., GHOFRANIPOUR, F. & MURTOMAA, H. 2008. Influence of mothers' oral health knowledge and attitudes on their children's dental health. *European Archives of Paediatric Dentistry*, 9, 79-83.
- SANDERS, A. E., SPENCER, A. J. & SLADE, G. D. 2006. Evaluating the role of dental behaviour in oral health inequalities. *Community Dentistry and Oral Epidemiology*, 34, 71-9.

- SANDERS, M. J. & VAN OSS, T. 2013. *Using Daily Routines to Promote Medication Adherence in Older Adults. The American Journal of Occupational Therapy*, 67, 91-99.
- SANZ, M., SERRANO, J., INIESTA, M., SANTA CRUZ, I. & HERRERA, D. 2013. *Antiplaque and antigingivitis toothpastes. Monographs in Oral Science*, 23, 27-44.
- SAVOLAINEN, J., SUOMINEN-TAIPALE, A., UUTELA, A., AROMAA, A., HARKANEN, T. & KNUUTTILA, M. 2009. *Sense of coherence associates with oral and general health behaviours. Community Dental Health*, 26, 197-203.
- SAVOLAINEN, J. J., SUOMINEN-TAIPALE, A. L., UUTELA, A. K., MARTELIN, T. P., NISKANEN, M. C. & KNUUTTILA, M. L. 2005. *Sense of coherence as a determinant of toothbrushing frequency and level of oral hygiene. Journal of Periodontology*, 76, 1006-12.
- SAWYER, S. M. & FARDY, H. J. 2003. *Bridging the gap between doctors' and patients' expectations of asthma management. Journal of Asthma*, 40, 131-138.
- SCHOU, L. & WIGHT, C. 1994. *Does dental health education affect inequalities in dental health? Community Dental Health*, 11, 97-100.
- SCOTTISH INTERCOLLEGIATE NETWORK GUIDELINES. 2014. *SIGN 138. Dental interventions to prevent caries in children. A national clinical guideline. [Online]. Available: <http://www.sign.ac.uk/pdf/SIGN138.pdf> [Accessed January 2015].*
- SCOTTISH NATIONAL DENTAL INSPECTION PROGRAMME. 2014. *Report of the 2014 Detailed National Dental Inspection Programme of Primary 1 children and the Basic Inspection of Primary 1 and Primary 7 children. [Online]. Available: <http://ndip.scottishdental.org/wp-content/uploads/2014/10/2014-10-28-NDIP-Report.pdf> [Accessed January 2015].*
- SELWITZ, R. H., ISMAIL, A. I. & PITTS, N. B. 2007. *Dental caries. Lancet*, 369, 51-9.
- SEOW, W. K., CLIFFORD, H., BATTISTUTTA, D., MORAWSKA, A. & HOLCOMBE, T. 2009. *Case-control study of early childhood caries in Australia. Caries Research*, 43, 25-35.
- SHAW, B. A., AGAHI, N. & KRAUSE, N. 2011. *Are changes in financial strain associated with changes in alcohol use and smoking among older adults? Journal of Studies on Alcohol and Drugs*, 72, 917.
- SHEERAN, P., AARTS, H., CUSTERS, R., RIVIS, A., WEBB, T. L. & COOKE, R. 2005. *The goal-dependent automaticity of drinking habits. British Journal of Social Psychology*, 44, 47-63.
- SHEERAN, P. & ORBELL, S. 1999. *Implementation intentions and repeated behaviour: Augmenting the predictive validity of the theory of planned behaviour. European Journal of Social Psychology*, 29, 349-369.
- SHEPHERD, R. 1999. *Social determinants of food choice. Proceedings of the Nutrition Society*, 58, 807-12.
- SILVERMAN, D. 2011. *Interpreting Qualitative Data. 4th ed. SAGE Publications.*
- SILVERMAN, D. 2013. *Doing Qualitative Research: A Practical Handbook. 3rd ed. SAGE Publications.*

- SJOGREN, K., BIRKHED, D., RANGMAR, S. & REINHOLD, A. C. 1996. Fluoride in the interdental area after two different post-brushing water rinsing procedures. *Caries Research*, 30, 194-9.
- SKEIE, M. S., RAADAL, M., STRAND, G. V. & ESPELID, I. 2006. The relationship between caries in the primary dentition at 5 years of age and permanent dentition at 10 years of age - a longitudinal study. *International Journal of Paediatric Dentistry*, 16, 152-60.
- SLADE, G. D., SANDERS, A. E., BILL, C. J. & DO, L. G. 2006. Risk factors for dental caries in the five-year-old South Australian population. *Australian Dental Journal*, 51, 130-9.
- SMITH, E. R. & DECOSTER, J. 2000. Dual-Process Models in Social and Cognitive Psychology: Conceptual Integration and Links to Underlying Memory Systems. *Personality & Social Psychology Review*, 4, 108-131
- SNOW, M., WHITE, G. L., ALDER, S. C. & STANFORD, J. B. 2006. Mentor's hand hygiene practices influence student's hand hygiene rates. *American Journal of Infection Control*, 34, 18-24.
- SOUTHWARD, L. H., ROBERTSON, A., EDELSTEIN, B. L., HANNA, H., WELLS-PARKER, E., BAGGETT, D. H., EKLUND, N. P., CRALL, J. J., SILBERMAN, S. L. & PARRISH, D. R. 2008. Oral health of young children in Mississippi Delta child care centers: a second look at early childhood caries risk assessment. *Journal of Public Health Dentistry*, 68, 188-95.
- SPITZ, A. S., WEBER-GASPARONI, K., KANELIS, M. J. & QIAN, F. 2006. Child temperament and risk factors for early childhood caries. *Journal of Dentistry for Children*, 73, 98-104.
- STANTON, B. F., XIAOMING, L., BLACK, M. M., RICARDO, I., GALBRAITH, J., FEIGELMAN, S. & KALJEE, L. 1996. Longitudinal stability and predictability of sexual perceptions, intentions, and behaviors among early adolescent African-Americans. *Journal of Adolescent Health*, 18, 10-19.
- STATACORP 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP.
- STATISTICS NORWAY. 2013. Dental status, by age. [Online]. Available: <https://www.ssb.no/en/tannhelse> [Accessed January 2015].
- STECKSEN-BLICKS, C., SUNNEGARDH, K. & BORSSSEN, E. 2004. Caries experience and background factors in 4-year-old children: Time trends 1967-2002. *Caries Research*, 38, 149-155.
- STOKES, E., ASHCROFT, A. & PLATT, M. J. 2006. Determining Liverpool adolescents' beliefs and attitudes in relation to oral health. *Health Education Research*, 21, 192-205.
- STRACK, F. & DEUTSCH, R. 2004. Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, 8, 220-247.
- STRAUSS, A. & CORBIN, J. M. 1990. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, SAGE Publications.
- STURGES, J. E. & HANRAHAN, K. J. 2004. Comparing Telephone and Face-to-Face Qualitative Interviewing: a Research Note. *Qualitative Research*, 4, 107-118.

- SYTSMA, S., KELLEY, M. & WYMER, J. 2001. Development and Initial Validation of the Child Routines Inventory. *Journal of Psychopathology and Behavioral Assessment*, 23, 241-251.
- TAYLOR, S. E. & BROWN, J. D. 1988. Illusion and well-being: a social psychological perspective on mental health. *Psychological Bulletin*, 103, 193-210.
- TEIXEIRA, P. J., CARRAÇA, E. V., MARKLAND, D., SILVA, M. N. & RYAN, R. M. 2012. Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioural Nutrition and Physical Activity*, 9, 78.
- TEN CATE, J. M., TIMMER, K., SHARIATI, M. & FEATHERSTONE, J. D. 1988. Effect of timing of fluoride treatment on enamel de- and remineralization in vitro: a pH-cycling study. *Caries Research*, 22, 20-6.
- THEMESSL-HUBER, M., FREEMAN, R., HUMPHRIS, G., MACGILLIVRAY, S. & TERZI, N. 2010. Empirical evidence of the relationship between parental and child dental fear: a structured review and meta-analysis. *International Journal of Paediatric Dentistry*, 20, 83-101.
- THENISCH, N. L., BACHMANN, L. M., IMFELD, T., LEISEBACH MINDER, T. & STEURER, J. 2006. Are mutans streptococci detected in preschool children a reliable predictive factor for dental caries risk? A systematic review. *Caries Research*, 40, 366-74.
- THOMBS, D. L., DOTTERER, S., OLDS, R. S., SHARP, K. E. & RAUB, C. G. 2004. A close look at why one social norms campaign did not reduce student drinking. *The Journal of American College Health*, 53, 61-8.
- THOMSON, W. M., POULTON, R., MILNE, B. J., CASPI, A., BROUGHTON, J. R. & AYERS, K. M. 2004. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. *Community Dentistry and Oral Epidemiology*, 32, 345-53.
- TICKLE, M., JONES, C., BUCHANNAN, K., MILSOM, K. M., BLINKHORN, A. S. & HUMPHRIS, G. M. 2009. A prospective study of dental anxiety in a cohort of children followed from 5 to 9 years of age. *International Journal of Paediatric Dentistry*, 19, 225-32.
- TRUBEY, R. J., MOORE, S. C. & CHESTNUTT, I. G. 2014. Parents' reasons for brushing or not brushing their child's teeth: a qualitative study. *International Journal of Paediatric Dentistry*, 24, 104-12.
- TSAKOS, G., BLAIR, Y. I., YUSUF, H., WRIGHT, W., WATT, R. G. & MACPHERSON, L. M. 2012. Developing a new self-reported scale of oral health outcomes for 5-year-old children (SOHO-5). *Health and Quality of Life Outcomes*, 10, 62.
- TUBERT-JEANNIN, S., AUCLAIR, C., AMSALLEM, E., TRAMINI, P., GERBAUD, L., RUFFIEUX, C., SCHULTE, A. G., KOCH, M. J., REGE-WALTHER, M. & ISMAIL, A. 2011. Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children. *Cochrane Database Systematic Review*, CD007592.
- TURNER, S., BREWSTER, L., KIDD, J., GNICH, W., BALL, G. E., MILBURN, K., PITTS, N. B., GOOLD, S., CONWAY, D. I. & MACPHERSON, L. M. 2010. Childsmile: the national child oral health improvement programme in Scotland. Part 2: Monitoring and delivery. *British Dental Journal*, 209, 79-83.
- TVERSKY, A. & KAHNEMAN, D. 1974. Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124-1131.

- UK MEDICINES INFORMATION. 2012. Q&A 357.2. What are the excipients in toothpastes? [Online]. Available: <http://www.ukmi.nhs.uk/filestore/ukmias/NWQA357.2Whataretheexcipientsintoothpastes.doc> [Accessed January 2015].
- UNITED STATES CENTERS FOR DISEASE CONTROL AND PREVENTION. 1999. *Ten Great Public Health Achievements -- United States, 1900-1999* [Online]. Available: <http://www.cdc.gov/MMWR/preview/mmwrhtml/00056796.htm> [Accessed January 2015].
- US SURGEON GENERAL. 2000. *Oral Health in America: A Report of the Surgeon General* [Online]. Available: <http://profiles.nlm.nih.gov/ps/retrieve/ResourceMetadata/NNBJT/> [Accessed January 2015].
- VAN DEN BRANDEN, S., VAN DEN BROUCKE, S., LEROY, R., DECLERCK, D. & HOPPENBROUWERS, K. 2013. Measuring determinants of oral health behaviour in parents of preschool children. *Community Dental Health*, 30, 19-25.
- VAN LOVEREN, C. & DUCKWORTH, R. M. 2013. Anti-calculus and whitening toothpastes. *Monographs in Oral Science*, 23, 61-74.
- VANOBERGEN, J., MARTENS, L., LESAFFRE, E., BOGAERTS, K. & DECLERCK, D. 2001. Assessing risk indicators for dental caries in the primary dentition. *Community Dentistry and Oral Epidemiology*, 29, 424-34.
- VERHOEVEN, A. A. C., ADRIAANSE, M. A., EVERS, C. & DE RIDDER, D. T. D. 2012. The power of habits: Unhealthy snacking behaviour is primarily predicted by habit strength. *British Journal of Health Psychology*, 17, 758-770.
- VERPLANKEN, B. 2006. Beyond frequency: Habit as mental construct. *British Journal of Social Psychology*, 45, 639-656.
- VERPLANKEN, B. & ORBELL, S. 2003. Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, 33, 1313-1330.
- VERPLANKEN, B., WALKER, I., DAVIS, A. & JURASEK, M. 2008. Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, 28, 121-127.
- VERPLANKEN, B. & WOOD, W. 2006. Interventions to Break and Create Consumer Habits. *Journal of Public Policy & Marketing*, 25, 90-103.
- WAGNER, G. J. & RYAN, G. W. 2004. Relationship between routinization of daily behaviors and medication adherence in HIV-positive drug users. *AIDS Patient Care and STDs*, 18, 385-393.
- WALLSTON, B. S., WALLSTON, K. A., KAPLAN, G. D. & MAIDES, S. A. 1976. Development and validation of the health locus of control (HLC) scale. *Journal of Consulting and Clinical Psychology*, 44, 580-5.
- WALSH, T., WORTHINGTON, H. V., GLENNY, A. M., APPELBE, P., MARINHO, V. C. & SHI, X. 2010. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Systematic Review*, CD007868.
- WATT, R. G. 2005. Strategies and approaches in oral disease prevention and health promotion. *Bulletin of the World Health Organization*, 83, 711-8.

- WATT, R. G. 2007. *From victim blaming to upstream action: tackling the social determinants of oral health inequalities*. *Community Dentistry and Oral Epidemiology*, 35, 1-11.
- WATT, R. G. & MARINHO, V. C. 2005. Does oral health promotion improve oral hygiene and gingival health? *Periodontology* 2000, 37, 35-47.
- WEBB, T. L. & SHEERAN, P. 2006. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, 132, 249-268.
- WECHSLER, H., NELSON, T. E., LEE, J. E., SEIBRING, M., LEWIS, C. & KEELING, R. P. 2003. Perception and reality: a national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use. *Journal of Studies on Alcohol*, 64, 484-94.
- WEDELL, D. H., SANTOYO, E. M. & PETTIBONE, J. C. 2005. The thick and the thin of it: Contextual effects in body perception. *Basic and Applied Social Psychology*, 27, 213-228.
- WEINSTEIN, P., HARRISON, R. & BENTON, T. 2006. Motivating mothers to prevent caries: confirming the beneficial effect of counseling. *The Journal of the American Dental Association*, 137, 789-93.
- WELSH GOVERNMENT. 2011. *Welsh Index of Multiple Deprivation (WIMD)* [Online]. Available: <http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en> [Accessed January 2015].
- WELSH GOVERNMENT. 2013. *Together for Health: A National Oral Health Plan for Wales 2013-18* [Online]. Available: <http://wales.gov.uk/docs/phhs/publications/130318oralhealthplanen.pdf> [Accessed January 2015].
- WELSH ORAL HEALTH INFORMATION UNIT. 2012. *Picture of Oral Health 2012. Dental epidemiological survey of 5 year olds, 2011-12*. [Online]. Available: http://www.cardiff.ac.uk/__data/assets/pdf_file/0004/48712/five-year-olds-2011-12-summary.pdf [Accessed January 2015].
- WHITE, D. A., CHADWICK, B. L., NUTTALL, N. M., CHESTNUTT, I. G. & STEELE, J. G. 2006. Oral health habits amongst children in the United Kingdom in 2003. *British Dental Journal*, 200, 487-91.
- WIGEN, T. I. & WANG, N. J. 2011. Maternal health and lifestyle, and caries experience in preschool children. A longitudinal study from pregnancy to age 5 yr. *European Journal of Oral Sciences*, 119, 463-8.
- WILLIS, G. B. 2005. *Cognitive Interviewing: A Tool for Improving Questionnaire Design*, SAGE Publications.
- WIND, M., KREMERS, S., THIJS, C. & BRUG, J. 2005. Toothbrushing at school. *Health Education*, 105, 53-61.
- WING, R. R. & JEFFERY, R. W. 1999. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of Consultancy and Clinical Psychology*, 67, 132-8.

WONG, M. C., GLENNY, A. M., TSANG, B. W., LO, E. C., WORTHINGTON, H. V. & MARINHO, V. C. 2010. Topical fluoride as a cause of dental fluorosis in children. *Cochrane Database Systematic Review*, CD007693.

WONG, M. C., LU, H. X. & LO, E. C. 2012. Caries increment over 2 years in preschool children: a life course approach. *International Journal of Paediatric Dentistry*, 22, 77-84.

WOOD, A. M., BROWN, G. D. A. & MALTBY, J. 2011. Thanks, but I'm Used to Better: A Relative Rank Model of Gratitude. *Emotion*, 11, 175-180.

WOOD, A. M., BROWN, G. D. A. & MALTBY, J. 2012a. Social Norm Influences on Evaluations of the Risks Associated with Alcohol Consumption: Applying the Rank-Based Decision by Sampling Model to Health Judgments. *Alcohol and Alcoholism*, 47, 57-62.

WOOD, A. M., BROWN, G. D. A., MALTBY, J. & WATKINSON, P. 2012b. How Are Personality Judgments Made? A Cognitive Model of Reference Group Effects, Personality Scale Responses, and Behavioral Reactions. *Journal of Personality*, 80, 1275-1311.

WOOD, W., TAM, L. & WITT, M. G. 2005. Changing circumstances, disrupting habits. *Journal of Personality and Social Psychology*, 88, 918.

WORLD HEALTH ORGANIZATION. 1986. *The Ottawa Charter for Health Promotion*. First International Conference on Health Promotion, Ottawa, 21 November 1986. [Online]. Available: <http://www.who.int/healthpromotion/conferences/previous/ottawa/en/> [Accessed January 2015].

YEVLAHOVA, D. & SATUR, J. 2009. Models for individual oral health promotion and their effectiveness: a systematic review. *Australian Dental Journal*, 54, 190-7.

9. APPENDICES

9.1. Appendix 1

Study 1: Participant Information Sheet and Consent Form



Designed to Smile Evaluation – Information for Parents

On behalf of the Welsh Assembly Government, Cardiff University are carrying out an evaluation of the school-based toothbrushing scheme, [Designed to Smile](#).

As one part of this evaluation, we are seeking the views of parents of children who take part in the programme through their nursery or school.

We've selected a mixture of schools from South and North Wales, and plan to carry out telephone interviews with around 20 parents to form the basis of a report to the Assembly.

The interviews will typically last no more than an hour, and will cover basic questions about your child's home toothbrushing habits and their experience of toothbrushing in school. Any information that you provide will not be personally attributed to you and will be anonymised in the final report of our evaluation to the Welsh Assembly Government.

Unless otherwise requested, the interview will be digitally recorded. This is simply to make it easier to analyse the interviews after they have finished. Once the interviews have been written up, the recordings will all be permanently deleted. Likewise, the data will be anonymised and stored securely so that any information provided during the interview will be kept confidential at all times.

If at any point during or after the interview, you decide that you'd like to withdraw from the evaluation, you are free to do so. The interview will be deleted and your data will not be used as part of the report.

If you have any questions at all, either before the interview or on the day, I'd be more than happy to answer them.

Kind regards,
Rob Trubey
Research Officer

Email: trubeyrj@cardiff.ac.uk

Tel: 029 2074 5469

Designed to Smile Evaluation – Consent Form

I have read and understood the details provided in the information sheet and hereby give my informed consent to participate in the evaluation. I am aware that the interview will be recorded, but that the data will be stored securely at all times and kept anonymous.

Likewise, I know that I can withdraw my participation at any point during or after the interview, in which case my data will be deleted.

Signed _____

Date _____

Designed to Smile Evaluation – Participant Details

School

Parent's name

Child's name

Child's age

Contact number (1)

Contact number (2)

Convenient time to call

9.2. Appendix 2

Study 1: Interview Schedule (A)

INTERVIEW SCHEDULE

INTRODUCTION

Before we start, I'll just explain a little bit about why we're doing these interviews. Firstly, we just want to get an idea of what parents like yourself feel about the Designed to Smile scheme – the school toothbrushing scheme – so that we can let the Welsh Government (who are paying for the scheme) know if parents think it's working and if there are any areas that could be improved in the future.

Secondly, as we're interviewing parents of children who take part in the scheme and these children are all fairly young like your son/daughter, we're interested in parents' experiences of toothbrushing at home – whether it's something you do, and the things that you think make it easier or harder for you.

We've spoken to a number of parents through this project, and through previous work, and we know that parents do lots of different things when it comes to toothbrushing. There are no right or wrong answers – we're really just interested in your own experiences, so I'd encourage you to be as honest as possible.

I'm not a dentist, or a dental professional, I just work as a researcher at the University. If you have any questions at all, I'll be happy to try and help but if I can't, I can certainly give you a phone number of someone from the Community Dental Service who will be able to answer them.

The questions are all fairly straightforward, but if there are any that you don't want to answer, that's fine – just say, and we'll move on to the next one. And of course, anything you say in the interview is entirely anonymous. When we report any findings, it won't be possible to identify any individuals.

OPENING QUESTIONS

How old is X?

And which school does he/she go to?

Do you know how long they've been taking part in the toothbrushing scheme?

What's your impression of the scheme?

What does X think about the scheme?

What do you think could be improved with the scheme?

KEY QUESTIONS

- (1) Tell me about your experience of brushing X's teeth at home...
- (2) What things do you think make brushing X's teeth easier, for you?
- (3) What things do you think make brushing X's teeth more difficult, for you?

CLOSING QUESTIONS

Was there anything we talked about that you wanted to go back to, or say anything more about?

Was there anything you think we missed, or something else you want to talk about?

Do you have any questions you wanted to ask me, at all?

INTERVIEW SCHEDULE

INTRODUCTION

Before we start, I'll just explain a little bit about why we're doing these interviews. Firstly, we just want to get an idea of what parents like yourself feel about the Designed to Smile scheme – the school toothbrushing scheme – so that we can let the Welsh Government (who are paying for the scheme) know if parents think it's working and if there are any areas that could be improved in the future.

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OPENING QUESTIONS

How old is X?

And which school does he/she go to?

Do you know how long they've been taking part in the toothbrushing scheme?

What's your impression of the scheme?

What does X think about the scheme?

What do you think could be improved with the scheme?

KEY QUESTIONS

- (1) Tell me about your experience of brushing X's teeth at home...
- (2) What things do you think make brushing X's teeth easier, for you?
- (3) What things do you think make brushing X's teeth more difficult, for you?
- (4) Describe a typical morning at home, before X goes to school....

Prompt: And what about the weekends?

- (5) Describe a typical evening at home, before X goes to bed....

Prompt: And what about the weekends?

- (6) What differences are there between brushing X's teeth in the morning and evening, for you?

CLOSING QUESTIONS

Was there anything we talked about that you wanted to go back to, or say anything more about?

Was there anything you think we missed, or something else you want to talk about?

Do you have any questions you wanted to ask me, at all?

INTERVIEW SCHEDULE

INTRODUCTION

Before we start, I'll just explain a little bit about why we're doing these interviews. Firstly, we just want to get an idea of what parents like yourself feel about the Designed to Smile scheme – the school toothbrushing scheme – so that we can let the Welsh Government (who are paying for the scheme) know if parents think it's working and if there are any areas that could be improved in the future.

Secondly, as we're interviewing parents of children who take part in the scheme and these children are all fairly young like your son/daughter, we're interested in parents' experiences of toothbrushing at home – whether it's something you do, and the things that you think make it easier or harder for you.

We've spoken to a number of parents through this project, and through previous work, and we know that parents do lots of different things when it comes to toothbrushing. There are no right or wrong answers – we're really just interested in your own experiences, so I'd encourage you to be as honest as possible.

I'm not a dentist, or a dental professional, I just work as a researcher at the University. If you have any questions at all, I'll be happy to try and help but if I can't, I can certainly give you a phone number of someone from the Community Dental Service who will be able to answer them.

The questions are all fairly straightforward, but if there are any that you don't want to answer, that's fine – just say, and we'll move on to the next one. And of course, anything you say in the interview is entirely anonymous. When we report any findings, it won't be possible to identify any individuals.

OPENING QUESTIONS

How old is X?

And which school does he/she go to?

Do you know how long they've been taking part in the toothbrushing scheme?

What's your impression of the scheme?

What does X think about the scheme?

What do you think could be improved with the scheme?

KEY QUESTIONS

- (1) Tell me about your experience of brushing X's teeth at home...
- (2) What things do you think make brushing X's teeth easier, for you?
- (3) What things do you think make brushing X's teeth more difficult, for you?
- (4) Describe a typical morning at home, before X goes to school....

Prompt: And what about the weekends?

- (5) Describe a typical evening at home, before X goes to bed....

Prompt: And what about the weekends?

- (6) What differences are there between brushing X's teeth in the morning and evening, for you?
- (7) What's the purpose of brushing X's teeth in the morning, for you?
- (8) What's the purpose of brushing X's teeth in the evening, for you?
- (9) What do you think other parents do with brushing their child's teeth at home?

CLOSING QUESTIONS

Was there anything we talked about that you wanted to go back to, or say anything more about?

Was there anything you think we missed, or something else you want to talk about?

Do you have any questions you wanted to ask me, at all?

9.3. Appendix 3

Study 2: Participant Information Sheet and Consent Form



Dear Parent/Guardian,

The Dental Public Health Unit at Cardiff University would like to invite you to take part in a survey about the Designed to Smile toothbrushing scheme which your child takes part in at school.

We've included some information about our survey below. If you are willing to taking part, you simply need to fill out the attached consent form with your address and we'll send you the questionnaire in the post, as well as a pre-paid and pre-addressed envelope for sending it back. If you have any questions at all, please feel free to get in touch with me on the number below.

PLEASE NOTE – IF YOU HAVE ALREADY COMPLETED A CONSENT FORM FOR ANOTHER CHILD THAT TAKES PART IN THE SCHEME, YOU DO NOT NEED TO COMPLETE ANOTHER ONE.

Dental Public Health Unit - 029 2074 5469

ABOUT THE PROJECT

What is the project about?

- For the last two years, we have been evaluating the Designed to Smile toothbrushing programme for the Welsh Government, who fund the scheme. We have spoken to the Designed to Smile dental staff, headteachers and classroom teachers in schools and some parents like yourself. By doing this, we've been able to get an idea of how the scheme works and how it can be improved in the future.
- Now we are hoping to find out the views of a larger number of parents, by sending a questionnaire in the post, which can be returned in a pre-paid and pre-addressed envelope. The survey is part of a research project which is going towards a PhD.
- We simply want to know what you think of the scheme, whether it has affected what you do at home in terms of toothbrushing with your child or children, and what you think about toothbrushing in general. Of course, if you have any suggestions about how the programme could be improved, we would definitely like to hear them as well.

Why have I been chosen to take part?

- We have chosen 15 schools from Swansea and Neath Port Talbot that take part in Designed to Smile, and the school which your child attends is one of those that was chosen. We have sent out these forms to each of the parents whose children take part in the programme in those schools.

Do I have to take part?

- No. Taking part in the survey is voluntary, and choosing not to take part will not affect your child's place in the toothbrushing scheme in any way. If you do not wish to take part, please tick the box on the consent form which says 'I do not wish to participate'.

If I do want to take part, what do I need to do?

- If you are happy to take part in the study, all you need to do is to fill in the consent form we've included and return it to the class teacher in the envelope provided. The form just asks for your address and a contact number. Once you've done that, we'll send you the questionnaire in the post, with some simple instructions on how to fill it out and a pre-paid and pre-addressed envelope for returning it to us.
- The questionnaire contains some basic questions about your child, followed by questions about their toothbrushing at home and in school. There are a few questions about the cost of toothbrushing and about morning and evening activities in the home, which will help us to understand how children brush their teeth. Finally, there are a few questions about how people budget for certain things, which we think may relate to how people make decisions about toothbrushing at home.

What will happen with the information I provide?

- The contact details you provide in the consent form will only be seen by the researcher responsible for the project, and will be used only to send you the questionnaire in the post. These details will be kept entirely confidential at all times and destroyed after the study ends. Likewise, any information you provide in the questionnaire will be seen only by the researcher, will be stored securely and will be kept entirely anonymous when we present our findings.

Who is organising and funding the research?

- The research is being carried out by Cardiff University, on behalf of the Welsh Government. The research is being part-funded by the Welsh Government.

Who has approved the work?

- All research in the NHS is looked at by independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and given favourable opinion by the Derby Research Ethics Proportionate Review Sub-Committee.

What if I have some questions about the study?

- If you would like any more information about the study, please feel free to contact me on the phone number provided below.

Many thanks for considering taking part in this survey. It really is important that we hear from as many parents as possible about their views of the Designed to Smile scheme and toothbrushing at home. Again, if you have any further questions about the study, you can speak to me on the number below.

Kind regards,
Rob Trubey
Research Officer
Dental Public Health Unit
Cardiff University Dental School
Heath Park, Cardiff
Tel: 029 2074 5469



CONSENT FORM

Please sign each of the four boxes below if you agree to take part and then fill in your signature, address and contact number below.

If you don't wish to take part in the survey, simply sign the box which says 'I do not wish to take part in the survey' and return the form.

Please sign your initials below



I confirm that I have read and understood the information sheet dated 15/02/12 (version 1.1). I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that taking part in the survey is voluntary and I am free to withdraw from the study at any point, without any effect on my child's participation in Designed to Smile.

I understand that information about me will be held at the Dental Public Health Unit at Cardiff University according to the 1998 Data Protection Act. I understand that this information will be kept strictly confidential and that no personal information will be used in the study report or other publications.

I agree to take part in the study

---OR---

I do not wish to take part in the study

Name and signature

Parent/caregiver's signature

Parent/caregiver's name

Child's name

Child's school

Contact details

Address 1

Address 2





Town/city

Post-code

Daytime telephone number

9.4. Appendix 4

Study 2: Questionnaire survey



Thank you for agreeing to take part in the Designed to Smile survey.

When you have finished completing the survey, you just need to place the questionnaire in the pre-paid and pre-addressed envelope provided and return it by post.

If you have any questions about the form, feel free to get in touch with survey coordinator Rob Trubey on 029 2074 5469.

About your child

All questions in this survey refer to the child who is currently taking part in Designed to Smile, and who is named in the covering letter.

This first section asks some basic questions about your child's age and gender, and their birth order.

1 How old is your child?

Write the age in the space below

_____ years _____ months

2 What gender is your child?

Tick one box only

Male ☐

Female ☐

3 How many *older* brothers or sisters does your child have?

Write a number in the space below

They have _____ older brothers/sisters

4 How many *younger* brothers or sisters does your child have?

Write a number in the space below

They have _____ younger brothers/sisters

Toothbrushing at home

The following questions are about your child's toothbrushing at home. If your child doesn't brush at home, just tick no to question 5 and skip straight to question 13.

5 Does your child brush their teeth (or have their teeth brushed) at home?

Tick one box only

Yes ☐

No ☐ go to **13**

6 Excluding what they do in school, how many times does your child brush their teeth (or have their teeth brushed) *each day*?

Write number in space below

_____ times per day

7 Who normally brushes your child's teeth at home?

Tick one box only

Child brushes on their own ☐

Adult brushes child's teeth for them ☐

Sometimes child brushes, sometimes adult brushes ☐

Child brushes with adult supervision ☐

Please note – all questions from this point on that talk about 'your child brushing' at home can mean either them brushing their own teeth, or you or another adult brushing their teeth for them.

8 At what age did your child start toothbrushing?

Write age in the spaces below

_____ Years _____ Months

9 Excluding what they do in school, how many times does your child brush their teeth each week?

Write number in space below

_____ times per week

The next question asks you to agree or disagree with a statement about how often your child brushes their teeth.

10 Please indicate whether you agree or disagree with the following statement:

"I am happy with how often my child's teeth are brushed each week"

Tick one box only

Strongly agree ☐

Agree ☐

Neutral ☐

Disagree ☐

Strongly disagree ☐

11 In a normal week, how often does your child brush their teeth in the morning?

Write number in space below

_____ times per week

12 In a normal week, how often does your child brush their teeth in the evening?

Write number in space below

_____ times per week

Other children at school

These four questions ask your opinion of how often you think other children in your child's school year brush their teeth (or have their teeth brushed) at home.

13 What do you think is the *maximum* number of times that any child in your child's school year brushes their teeth each week?

Write number in space below

_____ times per week

14 What do you think is the *minimum* number of times that any child in your child's school year brushes their teeth each week?

Write number in space below

_____ times per week

15 What do you think is the *average* number of times that a child in your child's school year brushes their teeth each week?

Write number in space below

_____ times per week

16 How do you think your child's brushing compares to other children in their school year?

Tick one box only

They brush less than all other children ☐

They brush less than most other children ☐

They brush about the same as most other children ☐

They brush more than most other children ☐

They brush more than all other children ☐

The next two questions ask you whether you agree with a set of statements about brushing your child's teeth, or making sure that they brush their teeth in the morning or the evening.

Please tick one box for each of the statements, to say whether you agree, disagree or are neutral towards it.

17 Please indicate how strongly you agree or disagree with the following statements about your child's toothbrushing at home:

Please tick one box in each row

Brushing my child's teeth or making sure they brush their teeth IN THE MORNING is something....

	Strongly agree ▼	Agree ▼	Neutral ▼	Disagree ▼	Strongly disagree ▼
I do frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do automatically	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without having to consciously remember	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that makes me feel weird if I don't do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without thinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that would require effort not to do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that belongs to the daily routine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I start doing before I realise I'm doing it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would find hard not to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have no need to think about doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that's typically 'me'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have been doing for a long time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Brushing my child's teeth or making sure they brush their teeth IN THE EVENING is something....

	Strongly agree ▼	Agree ▼	Neutral ▼	Disagree ▼	Strongly disagree ▼
I do frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do automatically	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without having to consciously remember	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that makes me feel weird if I don't do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do without thinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that would require effort not to do it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that belongs to the daily routine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I start doing before I realise I'm doing it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would find hard not to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have no need to think about doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
that's typically 'me'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have been doing for a long time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Morning and evening activities at home

The questions below refer to the daily tasks your child carries out in the morning and the evening, such as waking up, having breakfast, having an evening meal, etc. We just want to get an idea of whether or not there is a set routine for these things, or whether they are flexible and change from day to day.

18 In a typical week from Monday to Friday, to what extent does your child carry out the following morning and evening activities at the same time each day?

Please tick one box in each row

IN THE MORNING.... (Mon-Fri)	Always the same time ▼	Usually the same time ▼	Sometimes the same time ▼	Rarely the same time ▼	Never the same time ▼	Not applicable ▼
Waking up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having breakfast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a wash	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting dressed for school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leaving the house for school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IN THE EVENING....(Mon-Fri)	Always the same time ▼	Usually the same time ▼	Sometimes the same time ▼	Rarely the same time ▼	Never the same time ▼	Not applicable ▼
Getting home from school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having dinner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a wash before bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting changed for bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going to bed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The Designed to Smile scheme

We now want to ask you a few questions about the Designed to Smile scheme and how it affects your child's toothbrushing at home.

- 19** Since they have been brushing in school with Designed to Smile, how has this affected toothbrushing at home in the morning?

Tick one box only

They're more likely to brush in the morning ☐
They're less likely to brush in the morning ☐
It hasn't changed brushing in the morning ☐

- 20** Since they have been brushing in school with Designed to Smile, how has this affected toothbrushing at home in the evening?

Tick one box only

They're more likely to brush in the evening ☐
They're less likely to brush in the evening ☐
It hasn't changed brushing in the evening ☐

- 21** Since your child has started brushing in school, how has that affected *their* attitude towards brushing their teeth at home?

Tick one box only

They're more positive about brushing at home ☐
They're more negative about brushing at home ☐
It hasn't changed ☐

- 22** Since your child has started brushing in school, how has that affected *your* attitude towards brushing their teeth at home?

Tick one box only

I'm more positive about brushing at home ☐
I'm more negative about brushing at home ☐
It hasn't changed ☐

The cost of brushing

The following questions are about the cost of various toothbrushing materials like toothbrushes and toothpaste.

- 23** What is your impression of the cost of buying a toothbrush for your child in the shops?

Tick one box only

Very expensive ☐
Fairly expensive ☐
Not sure ☐
Fairly cheap ☐
Very cheap ☐

- 24** Has the cost of buying a toothbrush for your child ever put you off buying one?

Tick one box only

Yes ☐
No ☐

- 25** What is your impression of the cost of buying toothpaste for your child in the shops?

Tick one box only

Very expensive ☐
Fairly expensive ☐
Not sure ☐
Fairly cheap ☐
Very cheap ☐

- 26** Has the cost of buying toothpaste for your child ever put you off buying it?

Tick one box only

Yes ☐
No ☐

These two questions ask you to choose between five different types of toothpaste, and select the one that you would choose to use for your child in the morning, and then which one you would choose to use for your child in the evening.

Again, there are no right or wrong answers to these questions – we're just interested in your own preference.

27 Imagine there was a toothpaste made from two ingredients. The first ingredient, "Fresh", made children's breath smell fresh and their teeth look bright and shiny. The other ingredient, "Health", prevented tooth and gum disease for five years.

Imagine you can choose how much of each ingredient went into your child's toothpaste – but more of one ingredient means less of the other.

If you choose to have toothpaste made only from "Fresh" you get no "Health" and your child is more likely to have problems with their teeth and gums in five years. However, if you choose more "Health" then, while they are much less likely to suffer problems with their teeth and gums in the future, their mouths will not look or smell like they have been cleaned.

If you had the following five choices of toothpaste to use *in the morning*, which one would you choose to use for your child?

Please tick one box only

	FRESH		HEALTH		Choose one type of toothpaste to use in the morning
(1)	100%	FRESH	0%		<input type="checkbox"/>
(2)	75%	FRESH	25%		<input type="checkbox"/>
(3)	50%	FRESH	50%		<input type="checkbox"/>
(4)	25%	FRESH	75%		<input type="checkbox"/>
(5)	0%	HEALTH	100%		<input type="checkbox"/>

28 If you had the following five choices of toothpaste to use *in the evening*, which one would you choose to use for your child?

Please tick one box only

	FRESH		HEALTH		Choose one type of toothpaste to use in the evening
(1)	100%	FRESH	0%		<input type="checkbox"/>
(2)	75%	FRESH	25%		<input type="checkbox"/>
(3)	50%	FRESH	50%		<input type="checkbox"/>
(4)	25%	FRESH	75%		<input type="checkbox"/>
(5)	0%	HEALTH	100%		<input type="checkbox"/>

The following three questions ask you to make a choice between two imaginary options – an immediate reward, or a reward that you would receive at some point in the future.

We often make these types of choices in everyday life – there are no right or wrong answers, it's just a matter of preference.

We are interested in the way that people budget for certain things, and how this might relate to decisions about toothbrushing at home.

29 *Imagine you had a lottery ticket and had won £87, but you could not claim the £87 immediately – instead, you had to wait a while before you could claim your winnings.*

What is the least amount of money you would sell the ticket for today, if you had to wait 30 days (a month) before claiming the prize?

Write amount in spaces below

_____ pounds _____ pence

30 *What is the least amount of money you would sell the ticket for today, if you had to wait 90 days (3 months) before claiming the prize?*

Write amount in spaces below

_____ pounds _____ pence

31 *What is the least amount of money you would sell the ticket for today, if you had to wait 7 days (a week) before claiming the prize?*

Write amount in spaces below

_____ pounds _____ pence

At some point later this year, we plan to carry out some pen-and-paper exercises with parents, to follow up on the findings of this survey. The exercises would last no more than 30 minutes, and would be conducted somewhere convenient for you. Any travel costs would be paid in full.

If you would be willing to be considered for these exercises, please let us know by ticking the appropriate box below.

32 **Would you be willing to be contacted at a later date?**

Tick one box only

Yes ☐

No ☐

Thank you very much for taking the time to fill out this survey.


Please return the completed questionnaire using the pre-paid and addressed envelope that came with it.

If you have lost the envelope, please return to:

**Rob Trubey,
School of Dentistry,
Cardiff University,
Heath Park,
Cardiff
CF14 4GZ**

9.5. Appendix 5

Study 2: NHS REC ethical approval letter

	 Health Research Authority NRES Committee East Midlands - Derby Research Ethics Office The Old Chapel Royal Standard Place Nottingham NG1 6FS Telephone: 01158839440 Facsimile: 01159123300
 16 February 2012	
Professor Ivor G. Chestnutt Professor and Hon. Consultant in Dental Public Health Cardiff University Cardiff University Dental School Heath Park Campus Cardiff CF14 4XY	
Dear Professor Chestnutt,	
Study title:	Characteristics of parents and families: their influence on young children's oral health behaviour
REC reference:	12/EM/0070
Protocol number:	SPON1072-12
<p>Thank you for your letter of 15 February 2012, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.</p> <p>The revised documentation has been reviewed and approved by the sub-committee.</p>	
Confirmation of ethical opinion	
<p>On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.</p>	
Ethical review of research sites	
<p>The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).</p>	
Conditions of the favourable opinion	
<p>The favourable opinion is subject to the following conditions being met prior to the start of the study.</p> <p><u>Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.</u></p> <p><i>Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.</i></p>	
<small>A Research Ethics Committee established by the Health Research Authority</small>	

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at <http://www.rdforum.nhs.uk>.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. Confirmation should also be provided to host organisations together with relevant documentation.

Approved documents

The documents reviewed and approved by the Committee are:

Document	Version	Date
Evidence of insurance or indemnity		06 July 2011
Investigator CV		24 January 2012
Letter from Sponsor		13 January 2012
Letter of invitation to participant	1.0	23 January 2012
Other: Reminder Letter	1.0	23 January 2012
Other: CV for Rob Trubey	1.0	23 January 2012
Participant Consent Form	1.0	23 January 2012
Participant Information Sheet	1.1	15 February 2012
Participant Information Sheet: Reminder	1.1	15 February 2012
Protocol	1.0	23 January 2012
Questionnaire	1.0	23 January 2012
REC application		24 January 2012
Response to Request for Further Information		15 February 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments

- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

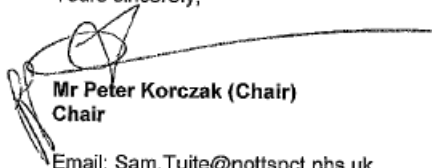
Further information is available at National Research Ethics Service website > After Review

12/EM/0070

Please quote this number on all correspondence

With the Committee's best wishes for the success of this project

Yours sincerely,



Mr Peter Korczak (Chair)
Chair

Email: Sam.Tuite@nottspct.nhs.uk

Enclosures: "After ethical review – guidance for researchers"

Copy to: Dr K Pittard Davies
Jemma Hughes, Research and Development
Rob Trubey

9.6. Appendix 6

Study 3: Participant Information Sheet, Consent Form and Debrief Sheet



Study Information Sheet

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve.

Please take time to read the following information carefully and ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the project about?

- For the last three years we have been carrying out an evaluation the Designed to Smile toothbrushing programme that is run in many nurseries and schools in Wales, including the one that your child currently attends. During our evaluation, we have spoken to the Designed to Smile dental staff, headteachers and classroom teachers in schools and sent out questionnaires that were completed by many parents like you about toothbrushing with their children at home.
- As a result of this work, we are interested in parents' attitudes towards toothbrushing at home – in particular, how healthy or unhealthy you think certain patterns of toothbrushing are.

Why have I been chosen to take part?

- We have chosen to invite parents from selected schools and nurseries in Swansea and Neath Port Talbot to take part in the study, because we particularly want to hear from parents who have young children aged between 0-6 year old.

Do I have to take part?

- No. Taking part in this study is voluntary. If you do not wish to take part, please tick the box on the consent form which says 'I do not wish to participate' and return it in the pre-paid envelope provided.

If I do want to take part, what do I need to do?

- If you are happy to take part in the study, all you need to do is to fill in the consent form attached to this sheet and return it in the pre-addressed and pre-paid envelope provided. If you have lost that envelope, you can send the form back to the address at the bottom of this letter.
- Once you've returned the form, I will call you on the contact number you provide and we can arrange a time and place for you to take part in the study that is convenient for you – whether that's at your home, at school when you collect your child, or in another convenient location.
- The study itself will simply involve looking at a list of when and how often various different parents brush their children's teeth at home and ticking a box to indicate how healthy or unhealthy you think each child's toothbrushing routine is. It's very straightforward and will take no more than 10-15 minutes to complete. The researcher will be there to answer any questions as you complete the study.

What will happen with the information I provide?

- All the information you provide in the study will be seen only by the researcher, will be stored securely at Cardiff University and will be kept entirely anonymous when we present our findings.

Who is organising and funding the research?

- The research is being carried out by Cardiff University, on behalf of the Welsh Government. The Welsh Government are funding the study.

What if I have some questions about the study?

- If you would like any more information about the study, please feel free to contact me on the phone number listed below.

Many thanks for considering taking part in this study. It really is important to us to understand the views of as many parents as possible.

Again, if you have any further questions about the study, you can speak to me on the number below.

029 2074 5469

Kind regards,

Rob Trubey
Research Officer
Dental Public Health Unit
Cardiff University Dental School
Heath Park, Cardiff
Tel: 029 2074 5469



Consent Form

Please sign each of the four boxes below if you agree to take part in the study and return the form in the envelope provided.

If you don't wish to take part in the study, simply sign the box which says 'I do not wish to take part in the study' and return the form.

Please sign your initials below
▼

I confirm that I have read and understood the information sheet. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that taking part in the survey is voluntary and I am free to withdraw from the study at any point, without any effect on my child's participation in Designed to Smile.

I understand that information about me will be held at the Dental Public Health Unit at Cardiff University according to the 1998 Data Protection Act. I understand that this information will be kept strictly confidential and that no personal information will be used in the study report or other publications.

I agree to take part in the study

---OR---

I do not wish to take part in the study

Name and signature

Parent/caregiver's signature

Parent/caregiver's name

Child's name

Child's school

Contact details

Address 1

Address 2

Town/city

Post-code

Daytime telephone number



Study Debrief Sheet

Thank you again for taking part in the study.

Here's a quick explanation of what we were looking at:

Each person received a slightly different list of parents and weekly brushing numbers. Some of the numbers (7 times a week, 14 times a week) were included for everybody.

We wanted to see three things:

- Whether the routines that everybody saw (i.e. 7 times per week) were rated any differently depending on whether the other numbers were mostly low (i.e. 2, 3, 4 times per week, etc.) or mostly high (i.e. 12, 13, 14 times per week)
- Whether people rated their own child's toothbrushing routine any differently when they had been shown mostly low weekly numbers (i.e. 2, 3, 4 times per week) or mostly high weekly numbers (i.e. 12, 13, 14 times per week)
- And finally, whether people thought that there was any health difference between brushing mostly in the morning or brushing mostly in the evening.

If you have any further questions about the study, please feel free to get in touch with me by e-mail or phone, using the contact details below.

With best wishes,

Rob Trubey
Research Officer
Dental Public Health Unit
Cardiff University Dental School
Heath Park
Cardiff
Tel: 029 2074 5469
Email: trubeyrj@cf.ac.uk

9.7. Appendix 7

Study 3: Cardiff University Dental School Ethics Committee approval letter

School of Dentistry
Dean Professor Michael A O Lewis
Ysgol Am Deintyddiaeth
Deon Yr Athro Michael A O Lewis

CARDIFF
UNIVERSITY
PRIFYSGOL
CAERDYDD

Cardiff University
School of Dentistry
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Cardiff CF14 4XY
Tel Ffôn +44(0)29 2074 2470
Fax Ffôn +44(0)29 2074 8274
E-mail E-bost
Dentaldean@cardiff.ac.uk
Prifysgol Caerdydd
Ysgol am Deintyddiaeth
Mynydd Blychan
Caerdydd CF14 4XY

DSREC Reference: 13/11

24th April 2013

Dr Robert J Trubey
Room 114, Dental Public Health
School of Dentistry
Cardiff University
Heath Park
Cardiff
CF14 4XY

Dear Mr Trubey

Re: Contextual Effects in the Evaluation of Tooth Brushing Routines

Thank you for your email dated 22nd April 2013 responding to the points raised by the Committee following the initial review of the above project on Monday 08th April 2013.

Ethical Opinion

On behalf of the committee I am pleased to confirm a favourable ethical opinion for the above research project.

Conditions of Approval

The Dental School Research Ethics Committee requires that any modification to the approved protocol be notified to the Committee.

It should be noted that Ethical Approval is valid for a period of two years from the date it was approved by the Dental School Research Ethics Committee. After this time, if the project has not commenced, you should reapply to the Dental School Research Ethics Committee.

To conform with Cardiff University requirements an annual monitoring form will be issued in due course, with regards to all approved projects.

With best wishes for the success of your study.

Yours sincerely

Dr Rebecca Playle
Dental School Research Ethics Committee

COPY Professor IC Chestnutt
Cardiff University School of Dentistry

Dr S Moore
Cardiff University School of Dentistry

Cardiff University is a registered charity, no. 1136855
Mae Prifysgol Caerdydd yn elusen gŵdnidydd, rhif 1136855

Dental School Research Ethics Committee

Documents Considered

Document	Version	Date Received
Letter to Head Teacher		22 nd April 2013
DSREC Application Form		27 th March 2013
Purpose and Academic Rationale	Version 1.0 25/03/2012	27 th March 2013
Covering Letter and Information Sheet - Parents	Version 1.0 25/03/2012	27 th March 2013
Covering Letter and Information Sheet – Parents through schools	Version 1.0 25/03/2012	27 th March 2013
Consent Form	Version 1.0 25/03/2012	27 th March 2013
Example Exercise Sheet	Version 1.0 25/03/2012	27 th March 2013

Done 22/11/13.

9.8. Appendix 8

Study 3: Example exercise sheet

INSTRUCTIONS (Page 1/6)

Before we ask you to complete the exercise, we'd just like to collect a few details about your child and how often they brush their teeth (or you brush their teeth for them) at home at the moment.

1 How old is your child?

Write the age in the space below

..... years months



2 What gender is your child?

Tick one box only

Male ☐

Female ☐

3 During a normal week (Monday – Sunday), how often does your child brush their teeth **at home** *in the morning*?

Write number in space below

..... times per week

4 During a normal week (Monday – Sunday), how often does your child brush their teeth **at home** *in the evening*?

Write number in space below

..... times per week

INSTRUCTIONS (Page 2/6)

This is a list of 9 parents who took part in a recent survey, showing how often they brush their child's teeth in a normal week at home.

Please take a couple of minutes to read through the list before moving on to the next page.

Parent	How many times they brush their child's teeth each week
Parent 1	8
Parent 2	2
Parent 3	7
Parent 4	11
Parent 5	5
Parent 6	9
Parent 7	14
Parent 8	6
Parent 9	10

INSTRUCTIONS (Page 3/6)

Here is the same list of parents again.

This time we'd like you to tick one box for each parent, to indicate how healthy or unhealthy you think **their child's weekly brushing routine** is. Take as long as you like to make your decisions.

Parent	How often they brush their child's teeth each week	Extremely unhealthy ▼	Neither healthy or unhealthy ▼								Extremely healthy ▼
Parent 1	8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 2	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 3	7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 4	11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 5	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 6	9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 7	14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 8	6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 9	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INSTRUCTIONS (Page 4/6)

Here is the same list of parents again. This time, as well as the total number of times their child brushes, we've also broken it down to show how often they brush in the morning and how often they brush in the evening over the course of a normal week.

8	am	4
	pm	4

So for example, would mean that the child brushes 8 times a week: 4 times in the morning and 4 times in the evening.

Again, please tick one box for each parent to rate how healthy or unhealthy you think their child's toothbrushing routine is.

Parent	How often they brush their child's teeth each week	Extremely unhealthy ▼	Neither healthy or unhealthy ▼	Extremely healthy ▼
Parent 1	8 am: 7 pm: 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 2	2 am: 2 pm: 0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 3	7 am: 7 pm: 0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 4	11 am: 7 pm: 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 5	5 am: 5 pm: 0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 6	9 am: 7 pm: 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 7	14 am: 7 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 8	6 am: 6 pm: 0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 9	10 am: 7 pm: 3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INSTRUCTIONS (Page 5/6)

And here is a slightly different list of parents. Again, we've broken it down to show how often parents brush their child's teeth in the morning and how often they brush in the evening over the course of a normal week.

8	am	4
	pm	4

So for example, would mean that the child brushes 8 times a week: 4 times in the morning and 4 times in the evening.

Please tick one box for each parent to rate how healthy or unhealthy you think their child's toothbrushing routine is.

Parent	How often they brush their child's teeth each week	Extremely unhealthy ▼	Neither healthy or unhealthy ▼	Extremely healthy ▼
Parent 1	8 am: 1 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 2	2 am: 0 pm: 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 3	7 am: 0 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 4	11 am: 4 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 5	5 am: 0 pm: 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 6	9 am: 2 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 7	14 am: 7 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 8	6 am: 0 pm: 6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent 9	10 am: 3 pm: 7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INSTRUCTIONS (Page 6/6)

On the first page, you told us how often your child brushes their teeth (or you brush their teeth for them) in a normal week at home.

Please tick one of the boxes below to indicate how healthy or unhealthy you think your own child's weekly toothbrushing routine is.

Extremely unhealthy			Neither healthy or unhealthy				Extremely healthy		
▼			▼				▼		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

And finally.....

During a normal week (Monday – Sunday), how often do you think an average child in your son or daughter's class brushes their teeth (or has their teeth brushed) at home?

Write number in space below

_____ times per week

Thank you for taking part in the study!

Please hand your exercise sheet in to the researcher and don't forget to collect your £10 shopping voucher!

9.9. Appendix 9

Journal of Paediatric Dentistry journal article, based on Study 1

Parents' reasons for brushing or not brushing their child's teeth: a qualitative study

ROB J. TRUBEY¹, SIMON C. MOORE² & IVOR G. CHESTNUTT¹

¹Applied Clinical Research and Public Health, Cardiff University School of Dentistry, Cardiff, UK, and ²Violence & Society Research Group, Cardiff University School of Dentistry, Cardiff, UK

International Journal of Paediatric Dentistry 2014; 24: 104–112

Background. Despite recent improvements in oral health, dental caries remains a significant source of morbidity for young children. Research has shown that regular toothbrushing with fluoride toothpaste reduces the risk of dental caries, but the factors that influence parental decisions about whether or not to brush their infant children's teeth at home are poorly understood.

Aim. To develop an in-depth understanding of the issues that parents face from socio-economically deprived areas when trying to brush their young children's teeth at home.

Design. Fifteen parents of children aged 3–6 years took part in semi-structured telephone interviews, discussing factors relating to brushing their child's

teeth at home. Thematic analysis was used to develop three themes.

Results. Parents discussed the difficulty of brushing their children's teeth in the evening, due to changing day-to-day routines, and the subsequent difficulty of forming a toothbrushing habit. Motivating factors for brushing children's teeth were largely short term. Satisfaction with brushing frequency was influenced more by perceptions of how often other parents brushed children's teeth than by the 'twice a day' norm or health outcomes.

Conclusion. Results are discussed in relation to research and theories from the psychology and behavioural economics literature, and comparisons are drawn with assumptions inherent in more traditional oral health promotion messages.

Introduction

Despite great improvements in oral health in recent decades, dental caries continues to be a significant source of morbidity for young children¹. As with many other health outcomes, there is a well-established link between childhood dental caries and socio-economic deprivation², with children from socioeconomically deprived areas typically experiencing more dental decay compared to those from more affluent areas.

Despite this social gradient in disease, there exists large variation in oral health outcomes for children within socio-economic groups. For instance, recent epidemiological data show that 5-year-old children resident in areas designated as the most deprived quintile in Wales experience a wide range of oral

health outcomes³. Although 42% of this cohort are caries free, the remaining 58% have on average 4.6 decayed, missing, or filled teeth.

The role of fluoridated toothpaste in preventing dental caries in children is beyond doubt⁴. Less than daily toothbrushing is a known risk factor for oral disease⁵, and research has demonstrated a clear benefit of twice-daily brushing compared to brushing just once a day or less^{5,6}. The variation in oral health outcomes for young children from similar socio-economic backgrounds is therefore suggestive of underlying differences in oral health behaviour such as toothbrushing and diet in the home environment while under the guidance of their parents or caregivers.

There has been relatively little research exploring the influence of parent's psychosocial attributes on their children's oral health behaviour⁷. A handful of cross-sectional studies have found children's oral health behaviour to be related to parental oral health

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knowledge⁸, attitude towards oral health⁹, and beliefs about oral health¹⁰. In terms of oral health promotion and intervention, however, there appears to be little evidence that changing people's attitudes, beliefs, or knowledge brings around long-term changes in oral health outcomes¹¹.

The current study used qualitative interviews to explore issues facing parents from socio-economically deprived areas when trying to brush their children's teeth at home. Qualitative research is particularly useful for 'giving a voice' to groups of people who are often overlooked in more conventional, quantitative research and provides the opportunity to 'gain an in-depth understanding of people's views, behaviour and decision-making processes from their own perspective'¹².

The aim of this study was to gain an in-depth understanding of the issues parents facing from socio-economically deprived backgrounds in relation to brushing their child's teeth at home.

Method

Recruitment and sampling

In total, 15 parents took part in the study. Parents were purposely recruited on the basis of their child's involvement in a national, school-based toothbrushing scheme called Designed to Smile. The programme involves children aged between 3 and 6 years and is run in nurseries and schools in areas of high socio-economic deprivation. As nursery and infant schools are populated by children from surrounding 'catchment areas', the parents and guardians of the children recruited were all from socio-economically deprived areas.

To access a varied group of participants and viewpoints, recruitment was facilitated by staff from the Community Dental Service (CDS). The CDS staff oversee the day-to-day running of the Designed to Smile scheme and have good relationships with schools and parents through their experience of working in the community.

Initially, six parents were recruited. After the initial interviews had been analysed, theoretical sampling¹³ was used, whereby parents

of slightly older (5 or 6 year old) children and parents who brushed their children's teeth infrequently were purposely recruited to inform and broaden some of the emerging themes and ideas from the earlier interviews.

All parents were approached in the school setting by oral health promotion staff from the Community Dental Service and asked whether they would be willing to take part in a telephone interview about their experience of toothbrushing with their child at home. They were given an information sheet explaining each aspect of the research. Parents who were interested in taking part were asked to complete a consent form with a contact number and were then contacted by the researcher to arrange a suitable time to conduct the interview.

Recruitment of participants ended when saturation occurred – that is, successive interviews were offering no new insights or challenges to the developing ideas and themes¹⁴.

Data collection

Data were collected via a series of in-depth interviews carried out over the telephone.

The interviews were semi-structured, following a brief interview schedule that was initially piloted with two parents, resulting in minor amendments. The interviews initially included three open questions:

- 1) Tell me about your experience of brushing your child's teeth at home?
- 2) What things make toothbrushing at home with your child easier, for you?
- 3) What things make toothbrushing with your child at home harder, for you?

The questions served only as a starting point, with the remainder of the interview directed by participant's reported experiences. A series of simple, probing follow-up questions or responses ('tell me more about that', 'why do you think that is?') were employed to motivate the interviewee to share as much information as possible.

As the research progressed and the initial stages of data analysis took place, the original interview schedule was added to and refined to elicit more information on emerging concepts and theories. For example, the first

group of participants spoke about toothbrushing as being part of their morning 'routine'. As a result, subsequent interviewees were asked about their typical morning and evening activities, to further explore the concept of 'daily routines' in relation to toothbrushing.

Data analysis

Each of the interviews was digitally recorded and transcribed in full.

Data analysis was guided by the principles of thematic analysis, an approach to analysing qualitative data that provide a method for 'identifying, analysing and reporting patterns (themes) within data'¹⁵.

Importantly, the research process was iterative: data analysis therefore took place throughout the research cycle, and recruitment and data collection were guided by the ongoing analysis and development of provisional concepts and themes. Figure 1 gives an overview of this iterative approach.

The stages of analysis were as follows:

- 1) Reading through interview transcripts in full to become familiar with the data
- 2) Going through transcripts in detail, creating 'primary codes' by labelling words, phrases, or sentences, which represented

parents' key ideas and thoughts about brushing their children's teeth at home

- 3) Combining together thematically similar primary codes to produce initial themes
- 4) Meeting with a second researcher, IGC, to read through transcripts and discuss codes and themes, to ensure inter-rater reliability and stimulate discussion and reflection about themes
- 5) Constantly reviewing themes throughout the research process to add, refine, or sometimes remove themes based on new primary codes or patterns in the data
- 6) Eventually defining and naming a small number of themes that are felt to adequately represent the full data set.

Ethics

The study was conducted as part of a larger service evaluation of the Designed to Smile toothbrushing scheme, on behalf of the Welsh Government. All parents gave informed consent before taking part in interviews, were aware of their right to withdraw from the study at any point, and gave permission for the interviews to be digitally recorded. Interview transcripts were all anonymised.

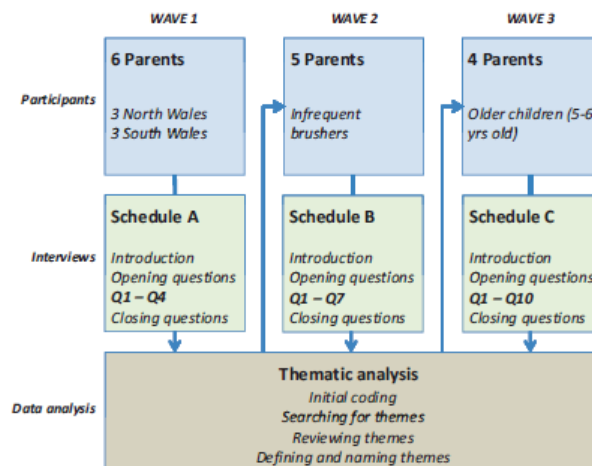


Figure 1. Iterative research process.

Results

Table 1 gives basic demographic details for each of the 15 participants in the study.

Three themes were generated from the data analysis, which were felt to represent the most salient issues addressed by the interviewees:

- 1) Toothbrushing routines and habits
- 2) Motivation for toothbrushing
- 3) Toothbrushing norms

These themes are considered below, with illustrative quotes provided.

Theme 1: Toothbrushing routines and habits

During early interviews, when parents were asked to talk in detail about their experiences of toothbrushing at home with their child, they frequently made reference to the context in which toothbrushing took place among all their other daily activities.

The result was that toothbrushing was essentially cued by these other events. For parents whose children brushed in the morning, for instance, it fitted in either before or after an event like waking up, eating breakfast, having a wash, bath, or shower, getting dressed in school clothes, and leaving home for school; whereas for those parents whose children brushed in the evening, it fitted in either before or after an event like

getting home from school, having dinner, doing homework, having a wash, bath, or shower, putting on pyjamas, and going to bed.

We're quite predictable – things happen in a certain order! So we always get up, have breakfast, then brush their teeth, then it's get changed and out we go!

Yeah, they have their bath, they come down and they have their supper, which is normally a glass of milk and a cookie and they go back up and brush their teeth before bed. Toilet and teeth! Toilet and teeth and then bed.

In subsequent interviews, parents were asked to describe a typical morning or evening at home, to get a sense of how – or if – brushing their children's teeth fitted into their overall routine.

It was evident that for a number of parents, evenings were a lot less stable or predictable than mornings. Mornings were reported to be 'hectic', but generally followed a similar pattern, whereas evening routines often changed from 1 day to the next.

There were a number of reasons for this, including changing work patterns and shifts and other parental distractions and, for slightly older children, occasional homework and after-school clubs. The result was that children were often left with friends or family after school and so got home and ate at different times throughout the week.

If we're really late, we'll eat out. Or general days, when we're back about five, you know, we'll have our dinner, then half past six, it'll be bath and we'll do their teeth whilst we're in the bathroom and they'll go to bed then. That's most days, but a hectic day we'll maybe just have tea and go straight to bed.

They just... at the end of the day, it's just hectic. Especially with after school things now. Because we've only just got in now [7:15 pm] and I like the kid's in bed for seven. That's their routine. But because we've started doing these extra outside of the school things now, we're rushing about and doing things. I'm reading books and we're doing homework now, so it's just hectic, so you just sometimes miss it. They need to be in bed, don't they?

Those parents whose routines – particularly evening routines – changed from 1 day to the next typically reported that brushing their children's teeth was a challenge or a struggle each day and was often missed as a result

Table 1. Demographic details of participants

Participant	Parent gender	Child gender	Child age	Reported brushing frequency
1	F	F	3	Twice a day
2	F	F	4	Once a day
3	F	M	4	Twice a day
4	F	M	4	Twice a day
5	M	F	5	Once/twice a day
6	F	M	3	Twice a day
7	F	F	3	Once a day
8	F	F	5	Rarely
9	F	M	4	Once a day
10	F	F	4	Once a day
11	F	M	4	Twice a day
12	F	M	5	Once/twice a day
13	F	F	6	Twice a day
14	M	F	6	Once a day
15	F	M	5	Twice a day

even when parents saw the value in evening brushing.

In contrast, parents whose morning or evening routines seemed to be consistent from 1 day to the next talked of children being in the 'habit' of brushing, implying that there was less deliberating about toothbrushing – it was something that 'just happened'.

They're just in a habit now. We don't have to talk about it really, they're just used to doing it... it's something they do, just like getting dressed or anything else.

Theme 2: Toothbrushing motivation

It was apparent that parents had a number of different reasons and motivations for brushing their children's teeth. Parents offered these explanations for brushing without any prompting initially, but later interviews were structured so that parents were asked more directly about the reason that they brushed their children's teeth in the morning and the evening.

Overwhelmingly, the motivation for brushing in the morning was short term: hygienic, in the sense that it made teeth *feel* clean and ensured fresh breath, and cosmetic in that it made teeth *look* clean.

You know, you want to make sure he has clean teeth, nice shiny teeth, when he goes to school.

The motivation for brushing children's teeth in the evening was more varied. Whereas parents were quick to give reasons for brushing their child's teeth in the morning, many parents (even those whose children regularly brushed twice a day) struggled to explain their reason for toothbrushing in the evening. In general, though, the benefits of evening brushing were seen as long term, occurring at some point in the future. There was a sense that evening brushing helped keep teeth 'healthy' and reduced the risk of future problems when children were 'older'.

I suppose it's getting rid of any bacteria and stuff, so that it doesn't cause her teeth to be rotten in the long run.

It's about putting on that toothpaste, and then it's all got night to work on his teeth, hasn't it? He's not eating then, so it's better, it's got time to work.

It was noticeable that the cosmetic and hygienic reasons most often given for morning brushing were strong motivating factors for many parents. Evening brushing was, by some parents, seen as something of a bonus by contrast. Indeed, a couple of parents struggled to see the point in evening brushing if their children were brushing in the morning.

I think in the morning, you just want to make sure they've got fresh breath and everything, but in the evening, well for me it's not as big a deal if they're brushing the next morning anyway.

One of the reasons that cosmetic factors were seen as important was that parents felt that their children's teeth were part of their overall appearance, likening it to their clothes or hair for instance. In this sense, parents felt that their children having dirty teeth would be obvious to teachers and other school or nursery staff and reflect badly on them as parents.

It's just general hygiene, isn't it? And their appearance. You wouldn't let them out of the door with muddy trousers, or food all over them, and their hair all scruffy, and everything, that wouldn't look good.

Theme 3: Toothbrushing norms

Over the course of the fifteen interviews, almost every parent made an unprompted reference to the twice-a-day toothbrushing 'norm' when discussing home brushing.

However, the extent that such a message was considered relevant to parents' decision making appeared to depend on their perception of how often they imagined other parents brushed their children's teeth. For parents who believed that very few other parents brushed their child's teeth twice a day, the message about what you *should* do was not considered credible.

Overall, there was a wide range of views on how often other parents were perceived to brush their children's teeth. Often it followed that parents who brushed their children's teeth frequently thought that most parents did the same, and those who brushed their children's teeth less often were sceptical of the idea that other children brushed regularly.

I imagine most parents brush their children's teeth twice a day, yeah? That's the message, isn't it? I don't think it's that big a thing, really, so yeah, I think most parents would be the same as us.

And everyone says it's twice a day you should do. But you're supposed to do lots of things! I think most parents are realistic... they don't all brush their children's teeth every day. You've got so much going on. It's just not going to happen is it? A lot of them won't ever do it, I bet!

When parents were asked how satisfied they were with how often their child brushed their teeth, they tended to focus more on making comparisons with 'other' parents and children than they did on tangible outcomes such as tooth decay or pain.

Some parents felt content with brushing their child's teeth once a day because they felt that was about average compared to other parents, whereas others expressed guilt or a desire to brush more often because they felt other parents may do more than themselves. One parent of a child who brushed twice a day even expressed anxiety about their routine, because she thought that some other parents might brush their child's teeth three times a day.

Well we do it twice a day because that's what I've always been told, I guess. I don't know if some people brush their children's teeth after lunch as well, on the weekend, I don't know... I guess I haven't thought about that... maybe that's something we could do, I suppose.

Discussion

The current study adopted a qualitative approach to explore some of the issues parents facing from socio-economically deprived backgrounds when trying to brush their children's teeth at home. Silverman¹⁶ has discussed the importance of establishing reliability and validity in qualitative research. In the present study, internal reliability was sought by means of involving a second researcher in reading through transcripts and discussing codes and themes, often referred to as inter-rater reliability¹⁷. To increase the validity of the findings, a form of respondent validity¹⁶ was employed, where later interviewees were asked more direct questions relating to ideas and themes that had been developed from earlier analysis.

Although there is naturally a limit to which findings in qualitative research can be generalised to the wider population, it is hoped that the broad themes discussed below will prove helpful in understanding some of the reasons that parents from socio-economically deprived backgrounds do or do not brush their children's teeth at home.

Consistent with previous research¹⁸, the current study found that toothbrushing at home was closely linked to other routine events that take place in the morning or evening. To the extent that toothbrushing appeared to be cued by other events, the day-to-day stability of morning and evening routines seemed to be an important factor in whether or not parents could initiate a toothbrushing 'habit' in their children. With children often left with friends or family in the evening, there is less opportunity for children to develop toothbrushing routine through primary socialisation – through learning from or receiving reinforcement from their parents or primary caregivers.

In the wider psychology literature, habits are defined as behaviours that exhibit 'automaticity', requiring minimal or no conscious thought¹⁹. Importantly, habits have been shown to be strong predictors of future behaviour, more so than having positive intentions to perform a behaviour²⁰.

The importance of stable routines for habit formation has been highlighted by both theoretical accounts and research in the field of medication adherence. Wood and colleagues²¹ present a model of habit formation in which repetitive behaviours are more likely to lead to habit formation when 'performed in stable circumstances – meaning in particular locations, at specific times...'. Wagner and Ryan found higher adherence levels to antiretroviral medication in adults whose day-to-day routines were more stable, concluding that 'the extent to which one's daily life is structured and routinised is an important factor in understanding medication adherence'²².

Traditionally, oral health educators and dental practitioners tend to emphasise the longer-term benefits of toothbrushing such as the prevention of dental disease. In the

current study, however, parents were more strongly motivated to brush their children's teeth by shorter term, cosmetic, or hygienic factors. Previous qualitative research has found that both adolescents and younger children tend to focus on cosmetic factors when discussing reasons for brushing their own teeth^{23,24}, but this is the first study to suggest that parents have a similar focus when brushing their infant children's teeth.

The idea that shorter-term benefits may hold more appeal than apparently larger longer-term benefits is consistent with findings in psychology and behavioural economics. It is found that many people inform their decisions through attending to more immediate outcomes and discount the importance of delayed outcomes even when the value of these delayed outcomes is significantly greater²⁵, a phenomena sometimes referred to as myopia. There is, however, considerable variation in the extent with which people place importance on immediate and delayed outcomes: some people are more myopic than others. Moreover, the extent to which individuals exhibit such myopia has been linked to the likelihood with which they will engage in certain 'health protective' behaviours such as taking regular exercise or voluntary flu vaccinations²⁶.

Previous research has suggested a possible link between parents' oral health knowledge or literacy and their child's oral health behaviour⁸. In the current study, the overwhelming majority of parents were aware of – and often mentioned without prompting – the 'twice a day' toothbrushing norm, suggesting that this traditional oral health message was well understood among this group.

Parents' behaviour, however, appeared to be related to their perception of how often other parents *actually* brushed their child's teeth – what is commonly referred to as a 'descriptive norm', rather than the twice-a-day 'prescriptive norm'. In many instances, parents assumed that their own behaviour (whether they brushed their child's teeth frequently or infrequently) was similar to that of most other parents.

Recent research has suggested that adolescents tend to overestimate how often their

peers consume alcohol²⁷ and sweet drinks²⁸ and that the degree of overestimation is typically related to their own level of consumption²⁸. The findings of the current study suggest that parents may exhibit similar biases in their estimation of toothbrushing norms.

Peer group comparisons also appeared to exert some influence on how satisfied parents were with the frequency with which they brushed their child's teeth: some parents who brushed their child's teeth infrequently were nonetheless satisfied with their behaviour, due to their belief that most other parents acted similarly. These findings are consistent with research suggesting that satisfaction with a wide range of outcomes, such as personal income and body image, is heavily influenced by social comparisons^{29,30}.

The stability of day-to-day home routines, the perceived immediacy of the benefits of toothbrushing, and perceptions of how often other parents brush their children's teeth all appear to be important factors for parents from socio-economically deprived backgrounds when thinking about brushing their children's teeth at home. These areas are relatively unexplored in oral health research, but have received more attention in the wider health and psychology literature. Future research should be aimed at further understanding these issues in relation to dental and oral health and exploring the extent to which these insights may inform future oral health education and intervention initiatives.

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Conflict of interest

The authors declare no conflict of interest.

What this article adds

- Traditionally, oral health promotion has been based on an assumption that parents who brush their children's teeth infrequently do so because they have poor oral health knowledge or do not prioritise their child's oral health.
- This article suggests that other factors may actually be important in parental decision-making about home toothbrushing.

Why this article is important for paediatric dentists

- Paediatric dentists should be aware that many parents are motivated to brush their children's teeth by short term, cosmetic factors ('clean teeth', 'fresh breath') as much if not more than long-term factors such as reducing the risk of dental decay.
- Paediatric dentists should consider that in addition to the common 'twice-a-day' message (a prescriptive norm), parents may be influenced by what they believe most other parents actually do (a descriptive norm).
- Paediatric dentists should be aware that many parents from socio-economically deprived areas have very unstable day-to-day routines and so find it difficult to establish a twice-daily toothbrushing habit for their children.

References

- Pitts NB, Boyles J, Nugent ZJ, Thomas N, Pine CM. The dental caries experience of 5-year-old children in Great Britain (2005/6). Surveys co-ordinated by the British Association for the study of community dentistry. *Community Dent Health* 2007; **24**: 59–63.
- Bernabé E, Hobdell MH. Is income inequality related to childhood dental caries in rich countries? *J Am Dent Assoc* 2010; **141**: 143–149.
- Welsh Oral Health Information Unit. 2010: <http://www.cardiff.ac.uk/dentl/research/themes/applied-clinicalresearch/epidemiology/oralhealth/index.html>
- Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. [Meta-Analysis Review] 2010; **1**: CD007868.
- Pine CM, McGoldrick PM, Burnside G *et al*. An intervention programme to establish regular toothbrushing: understanding parents' beliefs and motivating children. *Int Dent J*. [Clinical Trial Randomized Controlled Trial] 2000; **50** (6 Suppl. 2): 312–323.
- Chestnutt IG, Schafer F, Jacobson AP, Stephen KW. The influence of toothbrushing frequency and post-brushing rinsing on caries experience in a caries clinical trial. *Community Dent Oral Epidemiol*. [Clinical Trial] 1998; **26**: 406–411.
- Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Parental influence and the development of dental caries in children aged 0–6 years: a systematic review of the literature. *J Dent* 2012; **40**: 873–885.
- Vann WF Jr, Lee JY, Baker D, Divaris K. Oral health literacy among female caregivers: impact on oral health outcomes in early childhood. *J Dent Res*. [Research Support, N.I.H., Extramural] 2010; **89**: 1395–1400.
- Buunk-Werkhoven YAB, Dijkstra A, van der Schans CP. Determinants of oral hygiene behavior: a study based on the theory of planned behavior. *Community Dent Oral Epidemiol* 2011; **39**: 250–259.
- Pine CM, Adair PM, Petersen PE *et al*. Developing explanatory models of health inequalities in childhood dental caries. *Community Dent Health*. [Multi-center Study Research Support, U.S. Gov't, P.H.S.] 2004; **21**(1 Suppl): 86–95.
- Watt RG. Strategies and approaches in oral disease prevention and health promotion. *Bull World Health Organ* 2005; **83**: 711–718.
- Hennink M, Bailey A, Hutter I. *Qualitative Research Methods*. London: SAGE Publications; 2010.
- Glaser BG, Strauss AL. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New Jersey: AldineTransactions, 1967.
- Corbin JM, Strauss A. Grounded theory research: procedures, canons, and evaluative criteria. *Qual Sociol* 1990; **13**: 3–21.
- Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006; **3**: 77–101.
- Silverman D. *Doing Qualitative Research*. London: SAGE Publications; 2009.
- Mason J. *Qualitative Researching*. London: SAGE Publications; 2002.
- Aunger R. Tooth brushing as routine behaviour. *Int Dent J* 2007; **57**: 364–376.
- Verplanken B, Orbell S. Reflections on past behavior: a self-report index of habit strength. *J Appl Soc Psychol* 2003; **33**: 1313–1330.
- Verplanken B. Beyond frequency: habit as mental construct. *Br J Soc Psychol* 2006; **45**(Pt 3): 639–656.
- Wood W, Neal DT. A new look at habits and the habit-goal interface. *Psychol Rev*. [Research Support, Non-U.S. Gov't Review] 2007; **114**: 843–863.
- Wagner GJ, Ryan GW. Relationship between routinization of daily behaviors and medication adherence in HIV-positive drug users. *AIDS Patient Care STDs*. [Research Support, U.S. Gov't, P.H.S.] 2004; **18**: 385–393.
- Stokes E, Ashcroft A, Platt MJ. Determining Liverpool adolescents' beliefs and attitudes in relation to oral health. *Health Educ Res*. [Research Support, Non-U.S. Gov't] 2006; **21**: 192–205.
- Gill P, Stewart K, Chetcuti D, Chestnutt IG. Children's understanding of and motivations for toothbrushing: a qualitative study. *Int J Dent Hyg*. [Research Support, Non-U.S. Gov't] 2011; **9**: 79–86.

- 25 Frederick S, Loewenstein G, O'Donoghue T. Time discounting and time preference: a critical review. *J Econ Lit* 2002; **40**: 351–401.
- 26 Bradford WD. The association between individual time preferences and health maintenance habits. *Med Decis Making* 2010; **30**: 99–112.
- 27 Perkins HW, Haines MP, Rice R. Misperceiving the college drinking norm and related problems: a nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *J Stud Alcohol* 2005; **66**: 470–478.
- 28 Lally P, Bartle N, Wardle J. Social norms and diet in adolescents. *Appetite* 2011; **57**: 623–627.
- 29 Brown GDA, Gardner J, Oswald AJ, Qian J. Does wage rank affect employees' well-being? *Ind Relat* 2008; **47**: 355–389.
- 30 Wedell DH, Santoyo EM, Pettibone JC. The thick and the thin of it: contextual effects in body perception. *Basic Appl Soc Psych* 2005; **27**: 213–228.

9.10. Appendix 10

Caries Research journal article, based on Study 2

Caries Research

Original Paper

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Children's Toothbrushing Frequency: The Influence of Parents' Rationale for Brushing, Habits and Family Routines

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Key Words

Children · Dental caries · Family · Habits · Health behaviour · Motivation · Oral health · Oral hygiene · Parents · Toothbrushing

Abstract

Objectives: To assess the relationship between parental and family factors and children's toothbrushing frequency at different times of day. **Methods:** A cross-sectional questionnaire survey of predominantly low-socio-economic status parents of children aged 3–6 years ($n = 296$) in South Wales, UK. Data were collected on the child's weekly toothbrushing frequency (morning and evening), the parents' rationale for brushing their child's teeth in the morning and evening, the strength of a parent's habit for brushing a child's teeth in the morning and evening, and the extent to which the family's daily routines were stable from day to day. Socio-demographic details were also collected. **Results:** Reported weekly brushing frequency was significantly ($p < 0.001$) higher in the morning (mean \pm SD: 6.57 ± 1.37) than the evening (mean \pm SD: 5.99 ± 2.15). Parents had significantly ($p < 0.001$) more interest in the cosmetic benefits of toothbrushing in the morning compared to the evening. Multivariate analysis showed that an increasing focus on the cosmetic benefits of toothbrushing was associated with significantly ($p < 0.05$) less weekly brushing in the evening. The extent to which

brushing a child's teeth was 'habitual' was significantly ($p < 0.001$) associated with weekly toothbrushing frequency at both times of day. **Conclusions:** Parents' rationale for brushing their children's teeth can vary at both an individual level and at different times of day. Understanding these variations is important in designing interventions to improve brushing frequency for at-risk children. The results also demonstrate habituation as being an important factor in understanding toothbrushing frequency. Further research is required to understand the mechanisms involved in habit formation and maintenance with children's oral hygiene behaviour.

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Conceptual models emphasise the importance of parents and family in influencing children's oral health behaviour [Fisher-Owens et al., 2007]. However, there is still only a limited understanding of the psycho-social factors that may influence parents' decisions about their child's oral health [Hooley et al., 2012].

Despite the complex aetiology of childhood dental caries, there is general agreement that the disease is largely preventable by individual behavioural factors [Harris et al., 2004]. In addition to the control of dietary sugar, there is good evidence that the regular use of fluoride toothpaste can significantly reduce the incidence and severity

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of childhood caries [Marinho et al., 2003; Walsh et al., 2010].

Twice-daily brushing with fluoride toothpaste is associated with better oral health outcomes for children than brushing once per day [Chestnutt et al., 1998] and is widely recommended [BASCD, 2009]. Studies indicate that not all parents currently do this [Pine et al., 2004]. However, little is known about whether any disparity exists between morning and evening brushing frequency, and the extent to which brushing children's teeth in the morning might be influenced by different factors than brushing their teeth in the evening.

Qualitative studies have found that both children and parents often focus on short-term, cosmetic benefits of toothbrushing, in contrast to the long-term benefits typically emphasised by clinicians. Gill et al. [2011] found, for instance, that children talked about wanting their teeth 'nice and fresh for school' or wanting to reduce the chance of having 'smelly breath'. Vermaire et al. [2010] used Q-methodology and found that many parents agreed with statements indicating that they brushed their child's teeth for 'fresh breath' or so that they would have a 'nice smile'. The authors identified five distinct groups of parents according to their pattern of responses to statements about brushing children's teeth, suggesting that there may be different 'cues to action' for different parents. More recently, the current authors interviewed 15 parents of children aged between 3 and 6 years, and found that many parents were highly motivated by the perceived cosmetic benefits of brushing their child's teeth in the morning. Parents drew comparisons between their child's 'clean teeth' and their general appearance, and felt that the appearance of their child reflected on their parenting skills [Trubey et al., 2014].

These studies raise the question of whether parents may have a different rationale for brushing their child's teeth in the morning and the evening. In the wider literature, there is a large body of research demonstrating that people tend to be more motivated to perform actions whose benefits they perceive to be as immediate, rather than delayed [Frederick et al., 2002]. However, no research has yet looked at how this might apply to understanding parents' decisions about their child's oral hygiene.

Researchers have also pointed to the importance of recognising toothbrushing as a 'routinised' behaviour [Aunger, 2007]. Qualitative studies have shown that parents who regularly brush their children's teeth often refer to the process as a habit or 'part of the daily routine' in the morning or evening [Cortes et al., 2012; Trubey et al.,

2014]. In the field of medicine, researchers have found that having predictable daily routines can help both children and adults with adherence to medication regimes [Wagner and Ryan, 2004; Greening et al., 2007]. There is evidence that the development of a habit can facilitate positive health behaviours like regular exercise and consumption of fruit and vegetables [Verplanken and Melkevik, 2008; de Bruijn, 2010]. Habits are defined as repeated actions that become 'automatic' – when they are repeated in stable contexts, they become cued by environmental stimuli rather than guided by intentions or deliberate thought [Wood and Neal, 2007]. To date, however, no quantitative research has attempted to measure habits or daily routines in relation to when and how often children have their teeth brushed at home.

Aims

The aims of this study were to establish whether: (1) there was any difference between how often parents brushed their child's teeth in the morning and the evening; (2) parents had different rationales for brushing children's teeth in the morning and the evening, and (3) brushing rationale, habit strength and routine stability were associated with the frequency of morning and evening brushing.

Materials and Methods

Study Design and Population

A cross-sectional postal survey was conducted in the Swansea and Neath Port Talbot local authorities in South Wales. All participants were volunteers who gave informed consent, and research ethics approval was granted by the National Health Service, National Research Ethics Committee, East Midlands, code 12/EM/0070.

The study population comprised parents or caregivers of children aged 3–6 years who were attending a nursery school or primary school involved in the government-funded Designed to Smile toothbrushing scheme [D2S, 2014]. This programme is targeted primarily at schools in high-need areas of the country, so the study population was purposely skewed towards parents resident in areas of higher socio-economic deprivation. Twenty nursery schools and schools were selected at random from a list provided by the Community Dental Service, and invitations were sent to all parents of children who met the age criteria of being 3–6 years old at the time of the survey ($n = 625$).

Measures

A short questionnaire survey was developed, based on themes developed from previous qualitative work [Trubey et al., 2014]. The survey was piloted on members of the sample population before being finalised ($n = 30$) and cognitive interviewing was conducted with a small number of parents ($n = 6$) to establish read-

27. Imagine there was a toothpaste made from two ingredients. The first ingredient, 'Fresh', made children's breath smell fresh and their teeth look bright and shiny. The other ingredient, 'Health', prevented tooth and gum disease for five years.

Imagine you can choose how much of each ingredient went into your child's toothpaste – but more of one ingredient means less of the other.

If you choose to have toothpaste made only from 'Fresh' you get no 'Health' and your child is more likely to have problems with their teeth and gums in five years. However, if you choose more 'Health' then, while they are much less likely to suffer problems with their teeth and gums in the future, their mouths will not look or smell like they have been cleaned.

If you had the following five choices of toothpaste to use in the morning, which one would you choose to use for your child?

Please tick one box only

Choose one type of toothpaste to use in the morning

FRESH		HEALTH	
(1) 100%	FRESH	0%	<input type="checkbox"/>
(2) 75%	FRESH	25%	<input type="checkbox"/>
(3) 50%	FRESH	50%	<input type="checkbox"/>
(4) 25%	FRESH	75%	<input type="checkbox"/>
(5) 0%	HEALTH	100%	<input type="checkbox"/>

28. If you had the following five choices of toothpaste to use in the evening, which one would you choose to use for your child?

Please tick one box only

Choose one type of toothpaste to use in the evening

FRESH		HEALTH	
(1) 100%	FRESH	0%	<input type="checkbox"/>
(2) 75%	FRESH	25%	<input type="checkbox"/>
(3) 50%	FRESH	50%	<input type="checkbox"/>
(4) 25%	FRESH	75%	<input type="checkbox"/>
(5) 0%	HEALTH	100%	<input type="checkbox"/>

Fig. 1. Toothpaste choice question as it was presented in the survey.

ability and comprehension of the questions. Due to changes made to the survey following piloting, data from the pilot surveys were not included in the final analysis.

Outcome Variable

The outcome measures were the frequency with which parents reported brushing their child's teeth each week (or the child brushed their own teeth), in the morning and the evening. Parents were asked 'In a normal week, how often do you brush your child's teeth (or do they brush their own teeth) at home, in the morning?' and 'In a normal week, how often do you brush your child's teeth (or do they brush their own teeth) at home, in the evening?'

Independent Variables

Rationale for Brushing. Parents were presented with a vignette in which they were asked to choose between one of five fictional types of toothpaste to use for brushing their child's teeth (fig. 1). They were asked to select a toothpaste to use for brushing their

child's teeth in the morning and then a toothpaste to use for brushing their child's teeth in the evening. The five choices varied according to the proportion of two fictional ingredients, 'fresh' (has cosmetic benefit, but no clinical benefit) and 'health' (has clinical benefit, but no cosmetic benefit). Parents could choose between toothpastes containing 0% 'fresh'/100% 'health', 25% 'fresh'/75% 'health', 50% 'fresh'/50% 'health', 75% 'fresh'/25% 'health' or 100% 'fresh'/0% 'health'.

Habit Strength. The extent to which parents found brushing their child's teeth to be 'habitual' was measured using the validated Self-Report Habit Index [Verplanken and Orbell, 2003]. Habit strength was recorded separately for morning brushing and evening brushing. The twelve-item Self-Report Habit Index measures the degree to which an action is 'automatic'. Statements used the stem 'Making sure my child brushes their teeth in the [morning/evening] is something...' and options included 'that I do automatically', 'that I do without thinking' and 'that belongs to my daily routine'. Responses to each statement were scored on a five-point scale and ranged from 'strongly agree' (+2) to 'strongly disagree'

(-2). Consistent with previous cross-sectional studies, two items ('I do frequently' and 'I have been doing for a long time') were excluded from the analysis to avoid artificially inflating the habit-behaviour relationship [de Bruijn, 2010]. Item responses were summed and separate scores for morning and evening habits were calculated for each parent, ranging from 20 (strongest habit) to -20 (weakest habit). Internal consistency was good for both morning (Cronbach's $\alpha = 0.95$) and evening habit strength ($\alpha = 0.98$).

Routine Stability. To measure the extent to which home routines in the morning and evening were stable from day to day, parents answered a five-item measure indicating whether certain household events ('waking up in the morning', 'having breakfast', 'having an evening meal', 'going to bed') occurred at consistent times throughout a normal week. Responses were scored on a five-point scale, ranging from 'always occurs at the same time' (+2) to 'never occurs at the same time' (-2). Separate scores were calculated for morning and evening routines for each parent, with scores ranging from 10 (most stable routine) to -10 (least stable routine). Internal consistency was good (morning: $\alpha = 0.78$; evening: $\alpha = 0.88$).

Control Variables

The survey measured the child's age, gender and the number of older and younger siblings. The socio-economic status of the child's family was derived from their home postcode using the Welsh Index of Multiple Deprivation (WIMD) [WIMD, 2011], a measure that assigns small geographical areas to one of five categories of deprivation ranging from least deprived (WIMD = 1) to most deprived (WIMD = 5).

Procedure

Recruitment of parents was aided by classroom teachers, who handed invitation letters, information sheets and consent forms to eligible parents and collected returned consents. Questionnaire surveys were sent directly in the post to consenting parents between July and September 2012 along with a covering letter. Both envelopes and covering letters were personalised using details from the consent form, consistent with best practice [Dillman, 2006]. Surveys were self-completed by parents and then returned to the researcher using a pre-addressed and pre-paid envelope. Non-respondents were contacted by telephone after 4 weeks and offered a replacement questionnaire survey. After a further 2 weeks, parents who had still not responded were re-contacted and again offered a replacement survey. At both points, any parents who indicated that they no longer wished to take part in the study were removed from the contact list.

Data Analysis

Data was analysed using SPSS v20 [IBM, 2011]. Frequency of weekly brushing and parental preferences for toothpaste (morning and evening) were not normally distributed (Shapiro-Wilk test, $p < 0.05$), so group differences were assessed using the non-parametric Wilcoxon signed-rank test, with Z scores reported.

Multivariate analyses were conducted using two outcome measures, 'number of missed toothbrushing sessions (morning)' and 'number of missed toothbrushing sessions (evening)'. These were recoded, continuous variables indicating how far parents fell below the 7 times per week brushing ideal. Thus, a parent who reported brushing their child's teeth 5 times a week in the morning would have a score of 2, while a parent who reported brushing their

Table 1. Demographic details of respondents

	n	Mean \pm SD
Child's age, months	290	59.3 \pm 13.6
Child's age when parent began brushing their teeth, months	285	11.5 \pm 6.8
Number of younger siblings in family	289	0.5 \pm 0.6
Number of older siblings in family	291	0.8 \pm 0.9
Child's gender		
Male	139 (47.3)	
Female	155 (52.7)	
Socio-economic status		
WIMD = 1 (least deprived)	11 (3.7)	
WIMD = 2	25 (8.5)	
WIMD = 3	66 (22.4)	
WIMD = 4	83 (28.2)	
WIMD = 5 (most deprived)	102 (34.7)	
Unknown	7 (2.4)	

Figures in parentheses indicate percentages.

child's teeth 7 times a week in the morning would be assigned a score of 0. Negative binomial regression was used as both outcome variables were count data which were overdispersed [Cameron and Trivedi, 2013]. Incident rate ratios (IRR) were therefore reported, as well as the 95% confidence intervals. IRR can be interpreted in a similar way to odds ratios. In this instance, the outcome variable was the number of times parents missed brushing their child's teeth in the course of a week. An IRR of 1.25, for instance, would mean that each one-unit increase in the selected variable would be associated with a 25% increase in the rate of missed weekly brushing sessions. An IRR of 0.75 would mean that each one-unit increase in the variable would be associated with a 25% reduction in the rate of missed brushing sessions. Bivariate analyses were conducted using Spearman's ρ . For all analyses, a p value of $p < 0.05$ was considered to be significant.

Results

In total, 298 parents returned completed and usable surveys, comprising a 48% response rate. Socio-economic status data were available for an additional 190 non-respondents, who completed consent forms but did not return a survey. There was no significant difference ($\chi^2 = 6.42$, $p = 0.17$) between respondents and non-respondents in terms of socio-economic status measured by WIMD quintile.

Table 1 shows a summary of the demographic details of the children and their families. Very small differences in baseline numbers exist between variables, due to item non-response.

Table 3. Negative binomial regression, modelling number of weekly missed toothbrushing sessions (evening)

Parameter	IRR (95% CI)
Strength of parent's habit for brushing child's teeth in the evening (per unit increase)	0.87 (0.85–0.90)**
Parent's toothpaste choice for evening brushing (per 25% increase in 'health' ingredient)	0.63 (0.44–0.91)*
Stability of day-to-day routines in the evening (per unit increase)	0.93 (0.85–1.01)
Socio-economic status	
WIMD = 1–3 (less deprived)	1.00 (ref.)
WIMD = 4–5 (more deprived)	2.07 (1.10–3.90)*
Child's gender	
Female	1.00 (ref.)
Male	1.25 (0.71–2.20)
Child's age (per month increase)	1.01 (0.99–1.02)
Child's age when parent first started brushing their teeth (per month increase)	1.03 (0.99–1.08)
Number of younger siblings in family (per unit increase)	1.18 (0.85–1.65)
Number of older siblings in family (per unit increase)	0.70 (0.43–1.15)

* $p < 0.05$; ** $p < 0.001$.

Routines and Habits

Bivariate analysis showed that having a more stable day-to-day routine in the morning was significantly associated with a stronger morning brushing habit ($r_s = 0.14$, $p < 0.05$) and the same association existed for evening routines and evening brushing habits ($r_s = 0.15$, $p < 0.05$). Routine stability was, however, not independently associated with morning or evening toothbrushing frequency in the multivariate analysis.

Discussion

This is the first study to consider possible differences in parents' rationale for brushing children's teeth in the morning and the evening. Using a vignette where parents selected different types of toothpaste, it was possible to demonstrate a tendency for parents to concentrate on more short-term, cosmetic benefits of brushing children's teeth in the morning compared to the evening. The results are consistent with previous qualitative studies that have found that both children and parents place a large emphasis on the cosmetic benefits of toothbrushing. Individual differences for the motivation to brush children's teeth existed between parents. Parents who placed more emphasis on the short-term benefits of toothbrushing were more likely to miss brushing their child's teeth in the evening.

The study was also the first study to measure the extent to which parental behaviour for brushing children's teeth was 'habitual', as defined in the wider health literature.

Parents who reported that brushing their child's teeth was less habitual missed significantly more brushing sessions throughout the week, both in the morning and the evening. The results echo findings in the wider health literature, where cross-sectional studies indicate that health behaviours which become habitual are carried out more consistently [de Bruijn, 2010]. There was also some evidence that parents who reported more predictable day-to-day routines had stronger habits for brushing their child's teeth at both times of day.

A number of limitations of the current study should be noted. The response rate to the study (48%) means that there is likely to be some non-response bias. Although there was no significant difference in socio-economic status between respondents and those who provided consent forms but did not respond, it is not possible to account for the parents who did not return a consent form at all. It might be expected that these parents would brush their children's teeth less often than those who did respond. The sample was also drawn from a relatively small geographical area and was fairly homogeneous in terms of socio-economic status, meaning that further research is needed to see if the concepts explored here may be relevant to other populations. Future research might, for instance, explore the extent to which parents from different socio-economic backgrounds vary in their rationale for brushing children's teeth. The outcome measures of children's brushing frequency rely on parent self-reports, meaning there is a risk of recall or social desirability bias, likely inflating the reported levels of weekly toothbrush-

ing. It should be noted, however, that numerous cross-sectional studies have found significant associations between parent-reported brushing frequencies for their children and objective measures of the child's oral health [Pine et al., 2004; Steckslen-Blicks et al., 2004; Peres et al., 2005]. These studies suggest that parental reports of their child's oral hygiene behaviour can be considered to have reasonable validity. Finally, a new measure of routine stability was used due to an absence of suitable, validated tools. The multi-item tool employed was based on previous qualitative work and showed good internal reliability, but further testing is needed to establish its validity.

While acknowledging these limitations, the results presented here point towards some implications for practitioners and those involved in oral health promotion and education. Persuasive messages are an important part of public health interventions aimed at encouraging people to adopt or increase the frequency of healthy behaviours. Much consideration has been given to the effect of message 'framing' on the persuasiveness of health messages for different individuals. Research suggests, for example, that some individuals are more reactive to 'gain-framed' messages (emphasis on the positive effects of doing something), while others react better to 'loss-framed' messages (emphasis on the negative effects of not doing something) [Rothman et al., 2006]. It may be that parents who focus on the short-term benefits of toothbrushing will be receptive to different types of oral health promotion messages than those who focus on longer-term benefits. Similarly, different messages may be more persuasive for promoting morning brushing and evening brushing.

Poor maternal self-efficacy for brushing children's teeth, high levels of maternal anxiety and perceived 'difficult' children have all been associated with poorer oral health and hygiene in children [Pine et al., 2004; Spitz et al., 2006; Seow et al., 2009]. The development of a habit for brushing children's teeth may be one way to protect against such risk factors. Indeed, Chapman and Ogden [2009] suggest that the benefits of developing a habit include 'cognitive economy; performance efficiency; low emotional engagement; low stress; and greater feelings of control'. Facilitating parents in the development of a habit for brushing their child's teeth should therefore be an important goal for any future oral health interventions. Longitudinal studies of habit formation and development with regard to brushing children's teeth would be useful to highlight key stages at which support and interventions could be most effective for parents.

The concept of toothbrushing behaviour as a routine or habitual behaviour has other implications for practi-

tioners and health promotion personnel. Habit theories are clear that actions become habituated or 'automatic' when regularly performed in stable contexts – 'in particular locations, at specific times' [Wood et al., 2005]. It is possible that overly proscriptive advice about exactly when to brush child's teeth (for instance, before or after breakfast) may actually obstruct parents in developing a habit of brushing their child's teeth, or even disrupt existing habits. Techniques such as 'motivational interviewing', where there is a focus on trying to integrate positive oral health behaviours into a parent's existing daily routines, have shown some promise in reducing the risk of children experiencing caries [Weinstein et al., 2006; Harrison et al., 2007].

The current study suggests that parents' rationale for brushing their children's teeth can vary at both an individual level, and at different times of day. Understanding these variations may be important for designing effective oral health promotion. The results also suggest that habit formation appears to be a particularly important factor in understanding regular toothbrushing frequency. Further research is required to understand the mechanisms involved in habit formation and maintenance with regard to children's oral hygiene behaviour.

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Disclosure Statement

None.

References

- Aunger R: Tooth brushing as routine behaviour. *Int Dent J* 2007;57:364–376.
- BASCD: UK Department of Health and British Association for the Study of Community Dentistry. Delivering better oral health. An evidence-based toolkit for prevention. http://www.oralhealthplatform.eu/sites/default/files/field/document/NHS_Delivering%20Better%20Oral%20Health.pdf, 2009.
- Cameron AC, Trivedi P: *Regression Analysis of Count Data*. Cambridge, Cambridge University Press, 2013.

- Chapman K, Ogden J: How do people change their diet? An exploration into mechanisms of dietary change. *J Health Psychol* 2009;14:1229–1242.
- Chestnutt IG, Schafer F, Jacobson AP, Stephen KW: The influence of toothbrushing frequency and post-brushing rinsing on caries experience in a caries clinical trial. *Community Dent Oral Epidemiol* 1998;26:406–411.
- Cortes DE, Restegui-Share L, Spiro III A, Garcia RE: Factors affecting children's oral health: perceptions among Latino parents. *J Public Health Dent* 2012;72:82–89.
- D2S: Designed to Smile. <http://www.designedtosmile.co.uk/home.html>, 2014.
- de Bruijn GJ: Understanding college students' fruit consumption. Integrating habit strength in the theory of planned behaviour. *Appetite* 2010;54:16–22.
- Dillman DA: Mail and Internet Surveys: The Tailored Design Method. Hoboken, Wiley, 2006.
- Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, Newacheck PW: Influences on children's oral health: a conceptual model. *Pediatrics* 2007;120:510–520.
- Frederick S, Loewenstein G, O'Donoghue T: Time discounting and time preference: a critical review. *J Econ Lit* 2002;40:351–401.
- Gill P, Stewart K, Chetcuti D, Chestnutt IG: Children's understanding of and motivations for toothbrushing: a qualitative study. *Int J Dent Hyg* 2011;9:79–86.
- Greening L, Stoppelbein L, Konishi C, Jordan SS, Moll G: Child routines and youths' adherence to treatment for type 1 diabetes. *J Pediatr Psychol* 2007;32:437–447.
- Harris R, Nicoll AD, Adair PM, Pine CM: Risk factors for dental caries in young children: a systematic review of the literature. *Community Dent Health* 2004;21:71–85.
- Harrison R, Benton T, Everson-Stewart S, Weinstein P: Effect of motivational interviewing on rates of early childhood caries: a randomized trial. *Pediatr Dent* 2007;29:16–22.
- Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N: Parental influence and the development of dental caries in children aged 0–6 years: a systematic review of the literature. *J Dent* 2012;40:873–885.
- IBM: SPSS Statistics for Windows, Version 20.0. Armonk, IBM Corp, 2011.
- Marinho VC, Higgins JP, Sheiham A, Logan S: Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003;1:CD002278.
- Peres MA, de Oliveira Latorre Mdo R, Sheiham A, Peres KG, Barros FC, Hernandez PG, Maas AM, Romano AR, Victora CG: Social and biological early life influences on severity of dental caries in children aged 6 years. *Community Dent Oral Epidemiol* 2005;33:53–63.
- Pine CM, Adair PM, Nicoll AD, Burnside G, Petersen PE, Beighton D, Gillett A, Anderson R, Anwar S, Brailsford S, Broukal Z, Chestnutt IG, Declerck D, Ping FX, Ferro R, Freeman R, Gugushe T, Harris R, Lin B, Lo EC, Maupome G, Moola MH, Naidoo S, Ramos-Gomez F, Samaranyake LP, Shahid S, Skeie MS, Splieth C, Sutton BK, Soo TC, Whelton H: International comparisons of health inequalities in childhood dental caries. *Community Dent Health* 2004;21:121–130.
- Rothman AJ, Bartels RD, Wlaschin J, Salovey P: The strategic use of gain- and loss-framed messages to promote healthy behavior: how theory can inform practice. *J Commun* 2006;56:S202–S220.
- Seow WK, Clifford H, Battistutta D, Morawska A, Holcombe T: Case-control study of early childhood caries in Australia. *Caries Res* 2009;43:25–35.
- Spitz AS, Weber-Gasparoni K, Kanellis MJ, Qian F: Child temperament and risk factors for early childhood caries. *J Dent Child (Chic)* 2006;73:98–104.
- Stecksen-Blicks C, Sunnegårdh K, Borssen E: Caries experience and background factors in 4-year-old children: time trends 1967–2002. *Caries Res* 2004;38:149–155.
- Trubey RJ, Moore SC, Chestnutt IG: Parents' reasons for brushing or not brushing their child's teeth: a qualitative study. *Int J Paediatr Dent* 2014;24:104–112.
- Vermaire JH, Hoogstraten J, van Loveren C, Poorterman JH, van Exel NJ: Attitudes towards oral health among parents of 6-year-old children at risk of developing caries. *Community Dent Oral Epidemiol* 2010;38:507–520.
- Verplanken B, Melkevik O: Predicting habit: the case of physical exercise. *Psychol Sport Exerc* 2008;9:15–26.
- Verplanken B, Orbell S: Reflections on past behavior: a self-report index of habit strength. *J Appl Soc Psychol* 2003;33:1313–1330.
- Wagner GJ, Ryan GW: Relationship between routinization of daily behaviors and medication adherence in HIV-positive drug users. *AIDS Patient Care STDs* 2004;18:385–393.
- Walsh T, Worthington HV, Glennly AM, Appelbe P, Marinho VC, Shi X: Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2010;1:CD007868.
- Weinstein P, Harrison R, Benton T: Motivating mothers to prevent caries: confirming the beneficial effect of counseling. *J Am Dent Assoc* 2006;137:789–793.
- WIMD: Welsh Government Welsh Index of Multiple Deprivation. <http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/>, 2011.
- Wood W, Neal DT: A new look at habits and the habit-goal interface. *Psychol Rev* 2007;114:843–863.
- Wood W, Tam L, Witt MG: Changing circumstances, disrupting habits. *J Pers Soc Psychol* 2005;88:918.

9.11. Appendix 11

Community Dental Health journal article, based on Study 2

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The association between parents' perceived social norms for toothbrushing and the frequency with which they report brushing their child's teeth

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Objectives: To determine whether parents' judgements on how often other parents brush their children's teeth are associated with the frequency with which they brush their own children's teeth, and their satisfaction with their child's brushing routine. **Methods:** A cross-sectional questionnaire survey completed by 297 parents of children aged 3–6. Parents were asked how often they brushed their own child's teeth per week, how often they thought other parents did so, and how satisfied they were with their child's toothbrushing routine. Demographic data were also collected. **Results:** The mean frequency that parents brushed their children's teeth was 12.5 times per week. Multiple regression analysis tested the relationship between parents' perceptions of other parents brushing frequency (mean 10.5 times per week) and how often they brushed their own child's teeth, controlling for socio-demographic factors, and yielded a positive association ($p < 0.001$). There was a positive association between parents' satisfaction with their child's brushing routine and the extent to which they thought it was better than that of the average child ($p < 0.001$). **Conclusions:** Parents' judgements on how frequently other parents brush their children's teeth are associated with their own behaviour and satisfaction. Re-framing oral health messages to include some form of social normative information ("most parents do this") may prove more persuasive than simple prescriptive advice ("you should do this").

Key words: oral health, toothbrushing, oral health promotion, caries, children, social norms

Introduction

Fluoride toothpaste has been shown to be effective in the prevention of caries in children (Marinho *et al.*, 2003). However, its efficacy is highly dependent on a number of behavioural factors, including the frequency of brushing. Clinical trials have demonstrated improved oral health outcomes for twice-daily brushing compared to brushing just once a day or less (Walsh *et al.*, 2010) and brushing children's teeth twice a day is widely recommended. Nevertheless, surveys conducted in the UK suggest that many parents of five-year children do not adhere to these guidelines (White *et al.*, 2006). While parents clearly play a key role in determining children's home toothbrushing habits, the factors which influence parents' decisions about when and how often to brush their children's teeth remain poorly understood (Hooley *et al.*, 2012).

Oral health promotion has typically focused on providing information and advice about best practice (Watt, 2005). However, cross-sectional studies find that parents' oral health knowledge does not always correspond with how often they report brushing their children's teeth (Blinkhorn *et al.*, 2001). Systematic reviews of oral health promotion also find that providing advice and information alone is not sufficient to change behaviour in the long term (Kay and Locker, 1998).

Recently, there has been a growing focus on the wider social and environmental determinants of health-related behaviours. One social factor which has been highlighted as influencing people's decisions about health is 'social norms': a person's perception of the "accepted standards of behaviour in social groups" (Cialdini *et al.*, 1990).

Researchers have distinguished between two types of norm that influence decisions about how to behave: "injunctive norms" and "descriptive norms" (Cialdini *et al.*, 1990). Injunctive norms refer to a person's belief about what significant others would expect them to do, or would approve of them doing. Buunk-Werkhoven and colleagues (2011), for example, measured perceived social norms for brushing and flossing behaviour by asking participants whether they believed friends, family and colleagues would "expect them to regularly brush or floss their teeth". In contrast, descriptive norms refer to a person's belief about what their peers *actually* do.

Table 1: Definition of terms used

Term	Definition and source
Social norm	The (explicit or implicit) generally accepted rules of a group that can guide group members' attitudes, beliefs and behaviour (Lally <i>et al.</i> , 2012)
Injunctive norm	A person's perception of how peers or significant others would expect them to behave (Cialdini <i>et al.</i> , 1990)
Descriptive norm	A person's perception of how often peers or significant others actually perform an action or behaviour (Cialdini <i>et al.</i> , 1990)
Social comparison	The process of comparing one's own behaviour with the perceived behaviour of others (Mussweiler, 2003)

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There is growing evidence that descriptive norms are an important factor in understanding people's health-related behaviour (Rivis and Sheeran, 2003). Studies of behaviour related to alcohol, smoking, exercise and diet have all shown that people's views of what their peers do are often closely aligned to their own behaviour. McAlaney and McMahon, for instance, demonstrated a significant correlation between UK students' perceptions of how often their peers drank alcohol and their own alcohol consumption: those who thought heavy drinking was more common among peers were more likely to be heavy drinkers themselves (McAlaney and McMahon, 2007). Similar results have been reported in relation to people's smoking, diet and exercise behaviour, for adolescents and adults (Ball *et al.*, 2010; Lally *et al.*, 2011).

Perceptions of what other people do can also affect a person's satisfaction with their own behaviour, through the process of 'social comparison'. Social comparison refers to the tendency to evaluate one's own behaviour or performance in relation to others, rather than against objective standards (Mussweiler, 2003). Students' perceived risk of developing alcohol-related disorders appear to be influenced by how they think their alcohol consumption compares with other students across the country, for instance (Wood *et al.*, 2012).

Unlike alcohol use, smoking and diet, it is unlikely that people will gain information about other people's toothbrushing behaviour through direct observation. Instead, they may assume that their own behaviour is normal and use that as a benchmark for what they imagine others do, a phenomenon referred to as the 'false-consensus effect' (Ross *et al.*, 1977). If parents' perceptions of what others do are related to how often they brush their own child's teeth, there would be important implications for oral health promotion and interventions aimed at parents. To date, the effect of social norms and social comparison has been relatively underexplored in relation to oral health. A recent qualitative study found that parents of young children had a tendency to compare their child's toothbrushing frequency with what they thought other children did (Trubey *et al.*, 2014). However, there have been no quantitative studies in this area.

The current study therefore aimed to assess whether: i, the frequency with which parents reported brushing their children's teeth at home was associated with their estimate of how often an 'average' parent brushed their child's teeth; ii, parents' satisfaction with their child's toothbrushing frequency was modified by comparisons with other parents and children.

Method

A cross-sectional postal survey was conducted in the Swansea and Neath Port Talbot local authorities in South Wales. All participants were volunteers who gave informed consent, and research ethics approval was granted by the National Health Service, National Research Ethics Committee, East Midlands, code 12/EM/0070.

The study population comprised parents or caregivers of children aged between three and six years of age who were attending a nursery or primary school involved in the government funded Designed to Smile tooth-brushing scheme in the Swansea and Neath Port Talbot local au-

thorities (D2S, 2014). This program primarily targeted schools in high-need areas of the country, so the study population was purposely skewed towards parents resident in areas of high socio-economic deprivation.

To determine the expected proportion of parents who reported brushing their child's teeth 14 times a week (twice a day) to within $\pm 5\%$ with a 95% confidence interval (2-sided), it was calculated that a final sample of at least 289 parents was required. The Community Dental Service provided a list of all schools taking part in the scheme in the two local authorities ($n=127$), from which twenty nursery and primary schools were selected at random. Invitations were sent to all parents of children who met the inclusion criteria of having children aged three and six years at the time of the survey ($n=625$), based on an estimated 50% response rate and allowing some margin of error.

A short questionnaire was developed, based on themes developed from a formative qualitative study (Trubey *et al.*, 2014) and with the assistance of the Community Dental Service and a consultant in Dental Public Health. The survey was piloted on members of the sample population before being finalised, using a combination of cognitive interviewing and mailing the survey to a small sample of 30 parents (Campanelli, 2008). Those who were included at the pilot stage were excluded from the main study. The questionnaire measured:

Own child's brushing frequency - How often parents reported brushing their own child's teeth (or how often the child brushed their own teeth) during a typical week at home. This was calculated by summing the answers from two separate questions: "In a normal week, how often do you brush your child's teeth (or does your child brush their own teeth) at home in the morning?" and "In a normal week, how often do you brush your child's teeth (or does your child brush their own teeth) at home in the evening?"

Perceived descriptive norm for brushing - The parents' estimate of how often an 'average' parent in their child's nursery or primary school class brushed their child's teeth at home in a typical week.

Satisfaction with child's brushing routine - A single-item five-point scale to determine parents level of agreement with the statement "I am satisfied with how often my child has their teeth brushed at home in a typical week". The item was scored from 1 to 5, with higher scores indicating higher levels of satisfaction.

Perceived cost of brushing - Parents were asked to indicate how expensive they thought it was to purchase toothbrushes and toothpaste for their children. Five answer options ranged from 'very expensive' to 'very cheap'.

Demographic details - Demographic details included the child's age and gender, the age at which the parent first started brushing the child's teeth and the number of other siblings in the household. Socio-economic status was assigned using quintiles from the Welsh Index of Multiple Deprivation (WIMD, 2012), derived from parents' home post-code.

The questionnaires were sent by post to consenting parents between July and September 2012 along with a covering letter. Both envelopes and covering letters were personalised using details from the consent form, consistent with best practice (Dillman, 2000). Surveys

were self-completed by parents and then returned to the researcher using a pre-addressed pre-paid envelope. Non-respondents were contacted by telephone after four weeks and offered a replacement questionnaire. After a further two weeks parents who had still not responded were re-contacted and again offered a further replacement. At both points, any parents who indicated that they no longer wished to take part in the study were removed from the contact list.

Data entry and analysis was carried out in SPSS v20. Multivariate analysis was used to explore factors associated with 'missed weekly brushing sessions'. This was a recoded, count variable indicating how far parents fell below the recommended 14 brushing occasions per week. Thus, a parent who reported brushing their child's teeth 10 times a week would have a score of 4, while a parent who reported brushing their child's teeth 14 times a week would be assigned a score of 0. The outcome variable was not normally distributed (Shapiro-Wilk test, $p < 0.05$), so simple linear regression was not considered appropriate. The variable matched a Poisson distribution, but was over-dispersed (the variance exceeded the mean). Therefore negative binomial regression models were used (Cameron and Trivedi, 2013). Incident Rate Ratios (IRR) are reported with 95% confidence intervals.

For the purposes of the multivariate analysis, the cost of toothbrushes and toothpaste variable was dichotomised with 'fairly expensive' and 'very expensive' combined and compared against all other answer options. Likewise, the descriptive norm variable was dichotomised with parents who thought an average parent brushed their child's teeth less than 10 times per week coded as having a 'low descriptive norm' and compared against parents who thought the norm was higher. Finally, because the sample was skewed towards those from more deprived areas, the socio-economic status variable was dichotomised to compare those from the most or next most deprived quintiles of the Welsh Index of Multiple Deprivation with those from all other quintiles. An intra-cluster correlation coefficient (ICCs) was calculated using a large one-way ANOVA, and indicated that there was no significant clustering of the outcome measure (missed weekly brushing sessions; $ICC = 0.00001$, $p = 0.61$) within schools or nurseries.

A social comparison score was calculated for each parent, using the difference between how often they reported brushing their own child's teeth each week and how often they thought the average parent brushed their child's teeth each week. Ordinal logistic regression was used to predict parents' satisfaction with their child's brushing routine.

Table 2. Summary of demographic and toothbrushing data

		<i>n</i> *	Mean	sd	Min	Max	%
<i>Demographics:</i>	Child's age (months)	290	59.3	13.6	18	82	
	No. of younger siblings	289	0.5	0.6	0	3	
	No. of older siblings	291	0.8	0.9	0	6	
	Child's gender						
	Male	139					47.3
	Female	155					52.7
Socio-economic status (deprivation quintile, WIMD)							
	WIMD=5 (Most deprived)	102					34.3
	WIMD=4	83					27.9
	WIMD=3	66					22.2
	WIMD=2	25					8.4
	WIMD=1 (Least deprived)	11					3.7
	Unknown	10					3.4
<i>Toothbrushing data:</i>							
	Reported weekly brushing frequency	297	12.5	2.5	4	14	
	Perceived descriptive norm	287	10.5	3.2	2	14	
<i>Parents' satisfaction with child's brushing routine:</i>							
<i>"I am satisfied with my child's weekly brushing routine"</i>							
	Strongly agree	141					48.0
	Agree	80					27.2
	Neither agree/disagree	31					10.5
	Disagree	29					9.9
	Strongly disagree	13					4.4

*n varies slightly between variables due to item non-response

Results

Completed questionnaires were received from 297 parents, representing a 47.5% response rate. Post-code data were available for an additional 190 non-respondents who completed consent forms but did not return a survey. There was no significant difference ($\chi^2=6.42$, $p=0.17$) between respondents and non-respondents in terms of socio-economic status measured by Welsh Index of Multiple Deprivation quintile.

Table 2 shows a summary of the key variables, including weekly brushing frequency, perceived descriptive norm for weekly brushing and various demographic details of the study participants.

Ten respondents (3%) did not provide an estimated descriptive norm, so were not included in the final analysis.

Self-reported behaviour and perceived norms

The average number of times that parents reported brushing their child's teeth at home was 12.5 (sd 2.5) times per week, with 214 parents (72%) reporting that they brushed their child's teeth 14 times per week, or twice each day. The mean estimate of how often an 'average' parent brushed their child's teeth was 10.5 (sd 3.1, range 2-14) times per week.

Relationship between perceived norms and self-reported behaviour

Table 3. Negative binomial regression analysis, exploring factors associated with how often parents missed weekly brushing sessions

Variable	Incident rate ratio	95% CI
Perceived descriptive norm <10 times per week	3.63**	1.94,6.79
Socio-economic status WIMD=4 or 5 †	2.39*	1.22,4.71
Perceived cost of toothbrushes/ paste as fairly/very expensive	1.02	0.54,1.91
Child's gender being male	1.48	0.82,2.64
Child's age (per month increase)	1.01	1.00,1.03
Child's age when parent started brushing their teeth (per month increase)	1.02	0.99,1.03
Number of siblings in family (per unit increase)	0.90	0.66,1.20

* $p<0.05$, ** $p<0.001$, † more deprived

Multiple regression analysis (Table 3) showed that parents who perceived the descriptive norm for brushing to be relatively low (0-9 times per week) missed significantly more weekly brushing sessions with their own child (IRR=3.63, $p<0.0001$) compared to those who thought the norm was higher. Parents from more socio-economically deprived areas (WIMD=4 or 5) also missed significantly more brushing sessions than those from less deprived areas (WIMD=1-3) (IRR=2.39, $p<0.05$). A parent's perception of the cost of toothpaste and toothbrushes and demographic factors such as the child's age, gender and number of siblings were not independently associated with the number of missed weekly brushing sessions.

Social comparison and satisfaction

The distribution of parents' social comparison scores is shown in Figure 1. Half of the parents surveyed thought that they brushed their own child's teeth more often than the average parent, while only 12% of parents believed that their child's routine was worse than average.

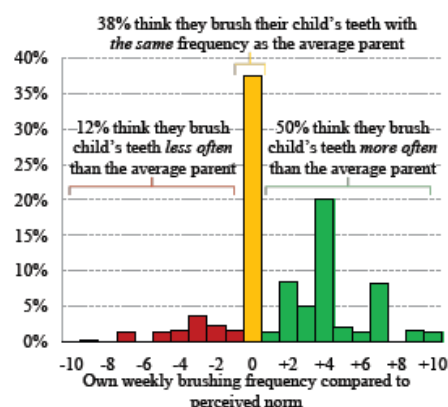


Figure 1. Distribution of social comparison scores

Ordinal logistic regression showed that a parent's social comparison score significantly predicted how satisfied they were with their child's brushing routine ($B=0.22$, $p<0.001$), independently of brushing frequency and other socio-demographic factors. Figure 2 illustrates average satisfaction levels, as measured by a five-point Likert scale, according to whether parents thought their child's brushing routine was better, equal or worse than that of their peers.

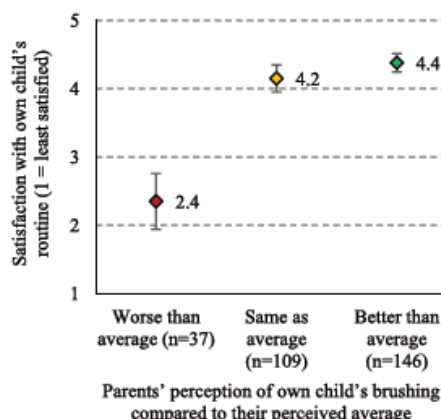


Figure 2. Effect of social comparison on parental satisfaction with child's brushing routine (with 95% confidence intervals)

Discussion

The results reported here show that parents' perceived descriptive norms for brushing were significantly associated with how often they brushed their own child's teeth. Parents who thought that other parents brushed their children's teeth regularly tended to brush their own child's teeth more often. This is consistent with findings from research in the wider health literature that suggests perceived descriptive norms are associated with behaviour in areas such as alcohol consumption, substance misuse, exercise frequency and food consumption (Lally *et al.*, 2011, McAlaney and McMahon, 2007). However, this is the first study to suggest that descriptive norms may influence parents' decisions about oral hygiene behaviour.

The results also showed that parents' satisfaction with their child's brushing routine was predicted by the difference between their own behaviour with what they believed other parents do. Satisfaction was greater when parents believed that their child brushed more often than a perceived 'average' child, even when actual brushing frequency was controlled for. This suggests that parents' judgements about what constitutes an appropriate oral hygiene routine are relative (determined by social comparison), rather than absolute (measured against objective standards). Parents who brush their own child's teeth less frequently than recommended may feel justified in their decisions if they perceive their behaviour to be 'normal', and so lack motivation to change.

The results echo findings from economic studies, where researchers have found that people's satisfaction with their salary depends on how they think it compares with that of their colleagues or peers rather than its absolute value (Boyce *et al.*, 2010). In health, people's perceptions of risk or vulnerability to disease also appear to be moderated by comparing themselves with others (Klein, 1997).

It is unclear why parents from similar socio-economic backgrounds should have such a range of different perceptions of how often other parents brush their children's teeth. In other areas of health, people's normative perceptions may be informed by direct observation. Researchers in the field of alcohol, for instance, have argued that overestimations of the drinking norm might result from a form of recall bias, where observing other people drinking alcohol and being drunk is more salient than seeing people drinking non-alcoholic drinks and being sober.

With oral hygiene behaviour, however, direct observation is less likely. The cross-sectional design of the survey means that it is not possible to be certain about the causal relationship between parents' own behaviour and their perceived norms. It is possible that parents simply use their own experience as a benchmark and distort their norms in the direction of their own behaviour: a phenomenon known as the false-consensus effect (Ross *et al.*, 1977). Future research may seek to explore the factors which influence people's normative perceptions in relation to oral hygiene behaviour, and to explore whether certain more proximal peer groups (such as close friends or family) might exert more influence than others.

The current study mirrored the methodology most often used in the social norm literature by using self-report measures of personal behaviour. It is important to acknowledge that the validity of self-report data may be limited: parents may exhibit a social desirability bias and exaggerate their own child's brushing frequency. Future research may seek to use objective oral health measures. Nonetheless, the results show a wide range of perceptions about the social norm for brushing and these perceptions are closely associated with parents' own self-reported behaviour.

Despite significant efforts to follow up non-respondents, the response rate to the survey means that there is likely to be some degree of non-respondent bias. Although there was no significant difference in socio-economic status between respondents and those who provided consent forms but did not respond, it is not possible to account for the parents who did not return a consent form at all. It might be expected, for instance, that these parents would brush their children's teeth less often than those who did respond. The sample was also drawn from a relatively small geographic area and was fairly homogenous in terms of socio-economic status, limiting the generalisability of the results. Further research is needed to see if the concepts explored here may be relevant to other populations. Finally, as the study was not specifically powered for the multiple regression analysis, there is some risk of type-II errors, where some of the non-significant findings may have reached significance with a larger sample of parents.

In the wider health literature, 'social normative interventions' have become increasingly prevalent in recent years. Such interventions are based on the idea that providing people with more accurate information about what their peers do will change perceived norms and therefore behaviour. A recent systematic review found that such interventions have led to improved outcomes with regard to alcohol and smoking in adolescent populations (Moreira *et al.*, 2009).

Current oral health promotion tends to focus on providing people with simple prescriptive advice ('you should brush your child's teeth twice a day'). The findings reported here suggest that some parents may be more motivated to change their behaviour by messages which convey some element of social information ('most other parents in your area brush their children's teeth twice a day'). Such an approach should be effective regardless of whether parents' perceptions of what others do informs their behaviour, or vice versa. In either case, challenging misperceptions and utilising people's tendency to compare themselves with their peers should result in parents re-appraising their own behaviour.

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References

- Ball, K., Jeffery R.W., Abbott, G., McNaughton, S.A. and Crawford, D. (2010): Is healthy behavior contagious: associations of social norms with physical activity and healthy eating. *The International Journal of Behavioral Nutrition and Physical Activity* 7, 86.
- Blinkhorn, A. S., Wainwright-Stringer, Y. M. and Holloway, P.J. (2001): Dental health knowledge and attitudes of regularly attending mothers of high-risk, pre-school children. *International Dental Journal* 51, 435-438.
- Boyce, C. J., Brown, G.D. and Moore, S.C. (2010): Money and happiness rank of income, not income, affects life satisfaction. *Psychological Science* 21, 471-475.
- Buunk-Werkhoven, Y.A.B., Dijkstra, A. and van der Schans, C.P. (2011): Determinants of oral hygiene behavior: a study based on the theory of planned behavior. *Community Dentistry and Oral Epidemiology* 39, 250-259.
- Cameron, A.C. and Trivedi, P. (2013): *Regression Analysis of Count Data*. Cambridge: Cambridge University Press.
- Campanelli, P. (2008): Testing survey questions. In: *International Handbook of Survey Methodology*: pp176-200.
- Cialdini, R.B., Reno, R.R. and Kallgren, C.A. (1990): A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology* 58, 1015.
- D2S (2014): *Designed to Smile*. www.designedtosmile.co.uk
- Dillman, D.A. (2000): *Mail and internet surveys: the tailored design method*. New York: Wiley.
- Hooley, M., Skouteris, H., Boganin, C., Satur, J. and Kilpatrick, N. (2012): Parental influence and the development of dental caries in children aged 0-6 years: a systematic review of the literature. *Journal of Dentistry* 40, 873-885.
- Kay, E. and Locker, D. (1998): A systematic review of the effectiveness of health promotion aimed at improving oral health. *Community Dental Health* 15, 132-144.
- Klein, W. M. (1997): Objective standards are not enough: affective, self-evaluative, and behavioral responses to social comparison information. *Journal of Personality and Social Psychology* 72, 763-774.
- Lally, P., Bartle, N. and Wardle, J. (2011): Social norms and diet in adolescents. *Appetite* 57, 623-627.
- Lally, P., Cooke, L., McGowan, L., Croker, H., Bartle, N. and Wardle J. (2012): Parents' misperceptions of social norms for pre-school children's snacking behaviour. *Public Health Nutrition* 1, 1-5.
- Marinho, V. C., Higgins, J.P., Sheiham, A. and Logan, S. (2003): Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews*, CD002278.
- McAlaney, J. and McMahon, J. (2007): Normative beliefs, misperceptions, and heavy episodic drinking in a British student sample. *Journal of Studies on Alcohol and Drugs* 68, 385.
- Moreira, M.T., Smith, L.A. and Foxcroft, D. (2009): Social norms interventions to reduce alcohol misuse in university or college students. *Cochrane Database of Systematic Reviews*, CD006748.
- Mussweiler, T. (2003): 'Everything is relative', Comparison processes in social judgment. The 2002 Jaspars Lecture. *European Journal of Social Psychology* 33, 719-733.
- Rivis, A. and Sheeran, P. (2003): Descriptive norms as an additional predictor in the theory of planned behaviour, A meta-analysis. *Current Psychology* 22, 218-233.
- Ross, L., Greene, D. and House, P. (1977): The false consensus effect: An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology* 13, 279-301.
- Trubey, R. J., Moore, S.C. and Chestnutt, I.G. (2014): Parents' reasons for brushing or not brushing their child's teeth: a qualitative study. *International Journal of Paediatric Dentistry* 24, 104-112.
- Walsh, T., Worthington, H.V., Glenny, A.M., Appelbe, P., Marinho V.C. and Shi, X. (2010): Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews*, CD007868.
- Watt, R.G. (2005): Strategies and approaches in oral disease prevention and health promotion. *Bulletin of the World Health Organization* 83, 711-718.
- White, D.A., Chadwick, B.L., Nuttall, N.M., Chestnutt, I.G. and Steele, J.G. (2006): Oral health habits amongst children in the United Kingdom in 2003. *British Dental Journal* 200, 487-491.
- WIMD (2012): *Welsh Index of Multiple Deprivation*. <http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en>
- Wood, A.M., Brown, G.D. and Maltby, J. (2012): Social norm influences on evaluations of the risks associated with alcohol consumption: applying the rank-based decision by sampling model to health judgments. *Alcohol* 47, 57-62.